

# RADIO PIONEERS

## 1945

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# 1945

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**Hotel Commodore, New York, N. Y.**
**November 8, 1945**

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**New York Section**
**INSTITUTE OF RADIO ENGINEERS**



DR. W. L. EVERITT
President, Institute of Radio Engineers and
Master of Ceremonies, Radio Pioneers 1945.

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## FOREWORD

Commemorating the "Radio Pioneers Party" of the New York Section of the Institute of Radio Engineers, this souvenir book attempts to present a thumbnail review of radio before 1926. If it stimulates the memories of the old timers, it will have achieved its purpose.

Inevitably, certain of the editors were able to contribute more fully than others. Especial mention is made of Lloyd Espenschied who, practically overnight, wrote the outline of history from the chronology by Donald McNicol; and of George H. Clark, confirmed radio historian, whose inexhaustible files made this book possible in the brief time available for its compilation. The preparation of the various committee lists was undertaken by Louis G. Pacent, Hugo Gernsback, and John di Blasi.


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G. C. CROM, JR.
M. CRONKHITE
P. CROSLEY, JR.
JOHN F. CROWLEY
B. R. CUMMINGS
G. B. CUMMINGS
A. L. CURTIS
E. A. CYRIAX
E. W. DANNALS
W. H. DAVIS
C. E. DEAN
A. DEANS
K. DECKER
L. DE FOREST
G. S. DESOUSA
H. M. DETRICK
D. DEWITT
W. F. DIEHL
C. J. DILKS
A. J. DILLON
C. F. DILLS
H. A. DIPALMA
DAVID F. DOODY
A. A. DOWERS
C. DREHER
H. DREYER
G. T. DROSTE
W. DUBILIER
A. DUNCAN
N. DUNHAM
O. E. DUNLAP
D. D. L. DUNN
G. EASH
M. E. EASON
M. EASTHAM
W. EDDY
G. V. ELTGROTH
G. ELTZ
E. W. ENGSTROM

G. W. ENTWHISTLE
L. ESPENSCHIED
C. F. ESTEY
F. A. FARALLA
C. FARAND
P. FARNSWORTH
P. J. FAULKNER
H. FAY
J. B. FERGUSON
W. G. H. FINCH
J. FORSHAY
C. E. FRAZER
F. FRENCH
J. A. FRIED
R. F. GATES
H. GERNSBACK
E. GIBBS
T. GIBLIN
T. GIBLUI
O. M. GLUNT
T. T. GOLDSMITH
W. N. GOODWIN, JR.
C. GRAFF
F. GREENWOOD
J. W. GREER
E. N. GREIBACH
J. GRIFFIN
W. M. GRIM
J. GRINAN
B. GROSS
H. GROVER
F. A. GUNTHER
C. D. GUTHRIE
H. GWYNN
A. HALL
J. M. HALL
H. E. HALLBORG
A. H. HALLORAN
L. A. HAMMARLUND
C. R. HANNA
E. HANSEN
L. A. HANSEN
A. HARDWICK
D. E. HARNETT
W. HARRISON
J. V. L. HARTLEY
F. X. HAYES
A. HAYNES
H. C. HAZEL
L. GRANT HECTOR
G. C. HEES
H. HEINDEL
R. A. HEISING
H. HELLER
V. HENDRICKSON
L. N. HIGGINS
J. M. HIGH
W. P. HILLIARD

F. A. Hinners
H. C. Hogencamp
L. C. F. Horle
C. W. Horn
J. L. Hornung
H. W. Houck
W. Howell
L. N. Hull
L. A. Hyland

J. Kelly Johnson
T. Johnson, Jr.

H. D. Kaulback
R. Keator
T. R. Kennedy
F. King
A. Kishpaugh
J. F. Knapp
W. Koren
F. W. Kranz
H. E. Kranz
L. R. Krumm

R. H. Langley
Paul Larsen
W. D. Laughlin
G. Layng
A. C. Lescarboura
F. Lester
Morris Levy
E. Lewis
O. I. Lewis
R. L. Lewis
H. C. Likel
D. G. Little
D. S. Little
Harold Lloyd
E. H. Loftin
A. E. Lyle
A. H. Lynch

I. G. Maloff
C. W. Maps
Charles Marcus
R. H. Marriott
R. E. Mathes
K. Mayers
F. Maynard
J. H. McCauley
P. McLean
R. H. McMann
S. McMinn
L. Mickey
B. F. Miessner
J. Millen
B. Miller
J. Miller
W. Mocelic
W. Mogey
A. P. Morgan
R. Morgan
J. Morley
L. E. Morrissey

E. Morse
F. Muller
R. Muller
A. G. Mundel
R. I. Myers

E. L. Nelson
L. C. Nichols
B. H. Noden
E. W. Noli

L. O'Cleary
O. Oehman
H. Oliver
A. C. Omberg
B. Ostman

R. Paret
J. H. Payne, Jr.
H. Pearson
T. T. Peters
R. Petrillo
S. E. Petrillo
E. N. Pickerill
W. P. Powers
J. H. Pressley
W. Priess
C. A. Priest

J. R. Ragazzini
L. F. Randolf
A. H. Rausch
F. X. Rettenmeyer
R. D. Rettenmeyer
W. Reuman
J. L. Reynolds
E. D. Rice
Joseph L. Richey
S. Richman
H. B. Richmond
J. F. Rider
D. Rigney
Evans Riley
W. Roche
M. Rose
U. B. Ross
G. T. Royden
C. R. Runyon
Philip T. Russel
J. Russell
F. M. Ryan

B. Salzberg
G. R. Sams
H. A. Saul
R. A. Sayres
W. F. Scanlan
O. Schairer
C. Schultz
H. M. Schwab
P. Schwerin
C. A. Service
C. Service, Jr.
Carl W. Service
H. S. Shea

C. M. Sherwood
E. R. Shute
M. Silver
W. C. Simon
G. Sleeper
M. B. Sleeper
J. O. Smith
D. Soulein
L. Spangenberg
J. A. Spencer
F. M. Squire
C. M. Srebroff
H. Stanley
J. J. Stantley
K. Stark
H. Steinbert
A. Stobbs
C. Stone
E. W. Stone
A. A. Stuart, Jr.
T. J. Styles
J. Swanson

S. Tarzian
H. Tasker
W. H. Taylor
F. Thiede
R. E. Thompson
L. T. Tindall
P. Trautwein
L. C. Truesdell
C. D. Tuska

J. G. Uzmann

J. B. Varian
I. Vermilya

A. F. Wallis
A. Walsh
J. C. Walter
P. Ware
K. B. Warner
W. L. Webb
J. Weinberger
P. Werner
J. White
S. Y. White
T. White
W. C. White
H. Wien
W. S. Wilson
G. V. Wiltee
W. K. Wing
L. E. Wittemore
M. C. Wright
N. Wunderlich

R. F. Yates
A. L. Young
F. C. Young
L. C. Young

M. Zaret
C. T. Zeoral

# THE INSTITUTE AND THE DEVELOPMENT OF RADIO

*By* John V. L. Hogan
Fellow and Past President, I. R. E.

*(Address before Radio Pioneers Dinner, November 8, 1945)*

JUST a few days more than twelve weeks ago, the Institute of Radio Engineers, and, indeed, radio itself, became two wars old. No one can state, with any determinable degree of accuracy, how much the Institute and its membership have contributed to the winning of those two wars. But radio communication was much used in World War I, and radio communication and control were well nigh indispensable in World War II; and I do not believe that I would be far wrong if I should say that the greater part of our radio development, both civil and military, has been based upon the work and the thinking of men who have been and are associated with the Institute of Radio Engineers.

I think we should all recognize that the record of the Institute, and of its members, is something to which we can point with a good deal of pride. It is far away greater than anything that was dreamed of in 1912 by the three men who planned the Institute, just as radio is far and away greater than anything that they dreamed of. Perhaps in another thirty-three years a second crop of Radio Pioneers, including some of us and our sons and our brothers, will be looking back at 1945 and either praising or condemning us according to how wisely we now plan for their future. Perhaps in 1978 there will be another opportunity for radio people and the industry to show whether or not they like what the Institute is doing, and, if there is, I hope that the applause will be as clear and loud as that which today's Institute has heard as hundreds of thousands of dollars clinked into the Building Fund.

In the early days of radio the two centers of activity were New York and Boston. New York had the American Marconi Company, de Forest and Shoemaker; the Boston area had Stone and Fessenden; Massie, with the aid of the Fall River Line, had a sphere of influence extending into both territories. Since the virus of radio seems to compel radio men to become gregarious, even in the face of company policies that favor secretiveness, it was probably inevitable that radio engineering groups should be formed in both cities. The Society of Wireless Telegraph Engineers gradually evolved from the somewhat academic atmosphere of the John Stone laboratories in Boston, at a date that I cannot now fix but which must have been well before I joined Fessenden at Brant Rock in December, 1909. The comparable New York organization was The Wireless Institute, which held its first meeting at the United Engineers' Building on March 10, 1909. That the primary object of societies like these was to aid in the development of radio is clearly shown by a letter that Bob Marriott, the first President of The Wireless Institute sent out to about two hundred people "interested in wireless" on May 14, 1908. I think that letter, which resulted in the forming of The Wireless Institute, is well worth reading, so here it is:



John V. L. Hogan

"Dear Sir:—

You have often thought no doubt that Wireless Telegraphy would be developed faster if those engaged in it would work together more.

The Electrical Engineers have come together in the United States by forming the American Institute of Electrical Engineers. This institution has helped to make better Electrical Engineering, better Electrical Engineers and better feeling between competitive firms.

Why should not we form the Institute of Wireless Engineers and pattern it after the American Institute of Electrical Engineers. The American Institute of Electrical Engineers' plan as applied to Wireless people would be briefly as follows:—

First: Any person interested in Wireless with proper recommendations, etc., would be eligible to associate membership.

Second: Any person having done valuable, original work in Wireless would be eligible to full membership.

Third: Any person whom the Society by vote, should decide upon, would be eligible to honorary membership.

Fourth: Meetings would be held once a month, at which papers on Wireless subjects would be read and criticised.

Fifth: Every member and associate would receive a copy of the papers read, together with the criticisms, thus giving absent members the same information as those present.

Sixth: A library of Wireless publications would be accumulated as rapidly as the funds of the Institute would permit. Each member or associate member would have access to this library.

Seventh: The Officers and Committees would be about as follows:—President, Vice-President, Manager, Treasurer and Secretary. Committees: — Executive Committee, Committee on Finances, Committee on Papers, Board of Examiners, Library Committee, Editing Committee and necessary special committees appointed from time to time.

Eighth: The dues would be possibly about $10.00 per year.

I believe an organization formed on a plan similar to the above would materially improve Wireless, increase the knowledge and ability of members, avoid friction between employees and employers, and to some extent between Wireless Companies.

Would you join such an organization as outlined? If so, please write me and give full expression of your views in regard to the matter in order that an organization may be formed on the right lines. Also such an organization might contemplate the establishment of a beneficiary association in connection with the Institute.

Yours very truly,

R. H. Marriott,
Ass't, Scientific Manager,
United Wireless Telegraph Co.,
42 Broadway, New York."

I hope you will particularly note the opening sentence, to the effect that "Wireless Telegraphy would be developed faster if those engaged in it would work together more". That very simple statement could well be a text for us today; it was true in 1908 and it still is true.

At the April, 1909, meeting Mr. Marriott delivered a paper entitled "The Wireless Institute", and in it he went farther into the Institute's relation to technological development. Referring to the constitution that had been adopted a month earlier, he said:

> "Regarding the object, 'To advance Wireless Telegraphy, Wireless Telephony, and kindred arts', Wireless Telegraphy is already of benefit to mankind, and the object is to make it of greater benefit; Wireless Telephony shows possibilities, and the object is to help make it beneficial . . ."

Here again we have an excellent expression of what an Institute like ours can and must do. An insight into how it can be done is given by a list of 26 titles that Mr. Marriott then proposed for projected papers. Many of them are good topics today, as they were in 1909, for instance:

> "The Recent Wireless Bills before Congress"
> "The Regulation of Amateur Stations"
> "Unnecessary Interference"
> "Static"
> "The Present Field for Wireless"
> "Aerials"

"Wireless Waves"

"How and What Wireless Operators should be Taught".

Now, I've been talking mostly about Bob Marriott, for his energy and foresight led to the founding of our progenitor, The Wireless Institute. But there was another, and younger man, who soon came into the picture. He was not an officer of the Institute, but with his B.S. degree and his position of Instructor of Physics in the College of the City of New York, he was keenly interested in the advancement of radio. His first appearance of record seems to be as of September, 1909, when he gave evidence of his inquiring and quantitative turn of mind by asking Harry Shoemaker "How do you determine the capacity for average transformers under ordinary conditions?" This was during the discussion following Shoemaker's paper on "The Production of High Frequency Oscillations", and I imagine that Harry was somewhat flabbergasted by Alfred's question. Probably he couldn't define an "average transformer" any better than the rest of us could, and I'm sure he knew nothing about "ordinary conditions". In those days there were no ordinary conditions in wireless,—everything was always extraordinary! Anyway, Shoemaker gave the incipient Doctor and Editor a very wise answer, beginning this way: "There are certain rules to follow, but you must have certain determinations before you can apply the mathematical formulae . . ." That, again, was true in 1909 and is true today.

I should not pass on to the formation of the Institute of Radio Engineers without telling you that just two months later, the possessor of that same inquiring brain, Alfred N. Goldsmith, delivered before The Wireless Institute a now genuinely historic paper under the title "Radio-Telephony", which he accurately termed "the youngest branch of electrical engineering". He deserves credit for what I regard as a keen analysis of what had been done up to that date, but perhaps even more for having omitted to prognosticate the use of radio telephony for the broadcasting of singing commercials. His conclusion was "It seems therefore so soon as certain obstacles, largely of a technical nature, can be overcome that the wireless telephone will have a wide field of application". He was right.

So now we must skip three years and look at 1912. The Boston activities of the Stone company seemed to be tapering off, and Fessenden's laboratory had been transferred from Brant Rock to the Bush Terminal in Brooklyn. Even before then the Stone physicists had dared to fraternize with the Fessenden engineers, and the Society of Wireless Telegraph Engineers profited from their joint interests and activities. But with most of its members moving to New York, something had to be done. To have two radio societies in this city seemed silly, so the two men I have mentioned, Marriott and Goldsmith, met with the erstwhile Secretary of the Society of Wireless Telegraph Engineers to see what could be done about it. To bring my talk to an early conclusion, let me say simply that the result was the consolidation of the two older Societies into the Institute of Radio Engineers.

The Institute of Radio Engineers was formally established on May 13, 1912, and the two founder societies went with the wind. Its first president was that perennial youth, Robert H. Marriott; its Editor of Publications was Alfred N. Goldsmith, and your speaker was active as a member of the Board and of the Committee on Standardization.

My theme has been the Institute and its relation to the development of radio, but I fear that the relationship must be taken as implicit rather than as explicitly detailed. As a matter of fact, you all know how important the Proceedings, the papers, the discussions and the work of the Standardization Committee have been. Rather than to listen to a dissertation on how a learned society can contribute to research.

By January 1, 1913, when the first yearbook was published, the Institute membership had increased to exactly 100. It has been growing ever since, as has its service to the development of radio. And I feel that its size, its influence and its service will continue to grow if all of us will keep on living up to Bob Marriott's creed of 1908—"radio will be developed faster if those engaged in it will work together more".

# HISTORY OF THE INSTITUTE OF RADIO ENGINEERS

THE Institute of Radio Engineers, the world's leading society in its field, came into being as a merger of two earlier associations, each one covering the same activities as the later I. R. E., although in a more restricted way.

First of these—in fact, it was the pioneer radio club in the United States—was the Society of Wireless Telegraph Engineers, in the beginning, a "wholly owned" technical gathering of the Stone Telegraph and Telephone Company, headed by John Stone Stone of revered memory. This society was incorporated under the laws of Massachusetts in 1908, though formed a year earlier. Its meetings generally were held at the home of Mr. Stone.

The origin of this association was clearly expressed by its founder in later years, when he said:

> "In 1907 it occurred to me that it would be a distinct advantage to each of us if we crystallized our ideas about our work into scientific papers, and that it would be of great value to all of us to hear and discuss such papers. I therefore organized the Society of Wireless Telegraph Engineers within the staff of the Stone Telegraph and Telephone Company. . . . The value of this Society to its members became so apparent that in 1908 it was decided to incorporate the Society and to extend the privilege of membership to radio engineers generally."



ROBERT H. MARRIOTT
First President, I.R.E., and Founder of Wireless Institute



JOHN STONE STONE
Fourth President I.R.E., and Founder of Society of Wireless Telegraph Engineers

Beginning with a group of eleven, the association grew to a membership of forty-three, through inclusion of the engineers of the Fessenden Company (the National Electric Signaling Co.), at Brant Rock, Mass., not far from Boston, and a few from greater distances, such as Dr. deForest, Fritz Lowenstein and others.

Meetings of the "Swatties" as the S. W. T. E. was called, for obvious reasons, not because its original members labored in the swampy and mosquito-ridden lands adjacent to the Charles River, were eagerly attended and papers of high caliber were delivered. A

few of these contributions deserve mention here.

ALTERNATING CURRENT ALGEBRA, by John Stone Stone.

HARMONICS IN ARC CIRCUITS, by E. D. Forbes.

A NEW METHOD FOR SOLVING PROBLEMS CONNECTED WITH THE PROPAGATION OF WAVES ALONG AN INFINITE LINE, by John Stone Stone.

A METHOD FOR OBTAINING UNITY POWER-FACTOR IN THE SUPPLY CIRCUITS OF WIRELESS TELEGRAPH STATIONS, by John Stone Stone.

TUBULAR CONDENSERS, by O. C. Roos.

AN EXPERIMENTAL VERIFICATION OF OLIVER HEAVISIDE'S THEORY OF THE INDUCTION OF CURRENTS IN CORES, by Roy T. Wells.

EXPERIMENTAL OBSERVATIONS ON THE AUDION, WITH SPECIAL REFERENCE TO APPLYING A POSITIVE POTENTIAL TO THE GRID, by Sewall Cabot.

EXPERIMENTAL OBSERVATIONS ON THE LOSS OF ENERGY IN THE DIELECTRICS OF COILS IN OSCILLATING CIRCUITS, by E. R. Cram.

THE PERIODICITIES AND DAMPING COEFFICIENTS OF COUPLED OSCILLATORS, by John Stone Stone.



DR. L. W. AUSTIN
Third President, I.R.E.



GREENLEAF W. PICKARD
Second President, I.R.E.

A somewhat similar organization had been founded among employees of the United Wireless Telegraph Company in and about New York City, under the leadership of Robert H. Marriott, a U. W. T. Co. engineer. The first meeting was held at 42 Broadway, New York, on January 23, 1909. In the membership were wireless engineers and executives, operators and installation engineers. Meetings were held either at 42 Broadway or at Columbia University. The initial membership of 14 increased to 99 by 1911.

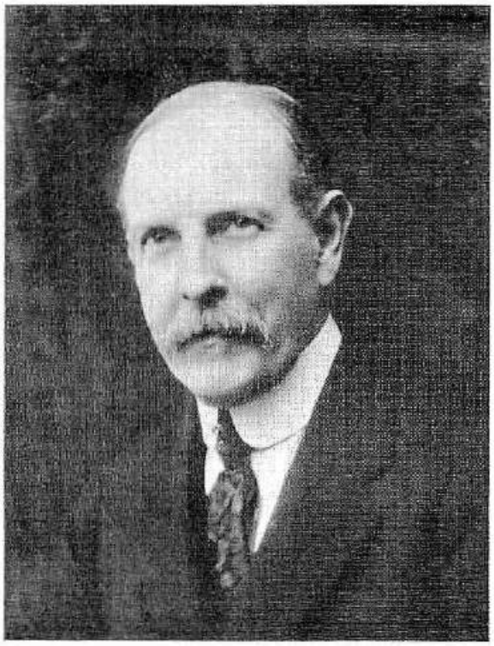
Important scientific and engineering papers were read at the Wireless Institute meetings, among which may be mentioned the following, delivered during the initial year of the organization:

ANTENNAE, by Greenleaf W. Pickard.

HOW BUSINESS CAN BEST BE HANDLED IN CASE OF DISTRESS, by J. R. Binns

THE PRODUCTION OF HIGH FREQUENCY OSCILLATIONS, by Harry Shoemaker.

PROPORTIONING THE TRANSMITTER TO AERIAL, by F. W. Midgley.



PROF. ARTHUR E. KENNELLY
Fifth President, I.R.E.

RADIO - TELEPHONY, by Alfred Norton Goldsmith.

The year 1911 was a crucial year for certain wireless companies, and equally critical for the wireless societies which they had founded. The Stone Telegraph and Telephone Company had bowed out of the picture by this time, and the Fessenden Company had moved its headquarters and laboratory from Brant Rock to Brooklyn, N. Y. Faced by these new conditions, the "Swatties" ceased to exist as such. At the same time, the Wireless Institute was declining rapidly. It had fallen to a membership of twenty-seven, due in great part to the indictment of several of its officers and the consequent receivership appointed for the company.

Before passing to the dramatic manner in which R. H. Marriott, president of the Wireless Institute since its inception, and John Stone Stone, pater familias of the S. W. T. E., managed to merge the two dying organizations into a single entity which has since risen to its present status, a list of charter members of these early societies should be recorded here for the sake of history, if for no other reason. They were:

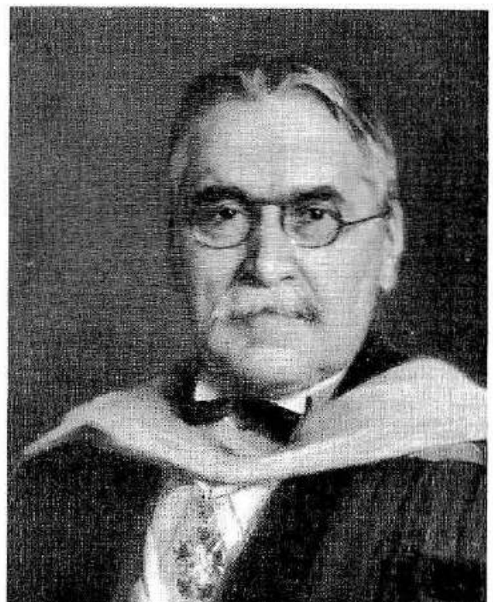
SOCIETY OF WIRELESS TELEGRAPH ENGINEERS

| | |
|---|---|
| J. C. ARMOR | F. A. KOLSTER |
| SEWALL CABOT | W. S. KROEGER |
| W. E. CHADBOURNE | FRITZ LOWENSTEIN |
| G. H. CLARK | WALTER W. MASSIE |
| E. R. CRAM | E. B. MOORE |
| G. S. DAVIS | G. W. PICKARD |
| LEE DE FOREST | SAMUEL REBER |
| V. F. GREAVES | OSCAR C. ROOS |
| J. V. L. HOGAN, JR. | JOHN STONE STONE |
| W. S. HOGG | E. W. SUNDBERG |
| GUY HILL | A. F. VAN DYCK |
| F. H. KNOWLTON | |

THE WIRELESS INSTITUTE

| | |
|---|---|
| WILLIAM F. BISSING | FRANK HINNERS |
| P. B. COLLISON | JAMES M. HOFFMAN |
| JAMES DAGES | ROBERT H. MARRIOTT |
| LLOYD ESPENSCHIED | A. F. PARKHURST |
| PHILIP FARNSWORTH | G. W. PICKARD |
| FRANK FAY | H. S. PRICE |
| EDWARD GAGE | A. RAU |
| ALFRED N. GOLDSMITH | EMIL J. SIMON |
| FRANCIS HART | C. H. SPHAR |
| ROBERT L. HATFIELD | FLOYD VANDERPOEL |
| ARTHUR A. HEBERT | R. A. WEAGANT |

With the S. W. T. E. membership divided by distance, and its parent organization disbanded, and with the W. I. membership in a critical condition which eventually followed its parent into desuetude, Robert Marriott



PROF. M. I. PUPIN
Sixth President, I.R.E.



PROF. GEORGE W. PIERCE
Seventh President, I.R.E.

decided that it would be advantageous for both former organizations to combine into a new society. He discussed the subject with John Stone Stone and found the latter entirely amenable to the suggestion. After several consultations it was decided that Mr. Marriott should proceed to put the idea into practice. Thus it is to Robert H. Marriott, and to him alone, that the initial plan of the I. R. E. is due. It was only fitting, therefore, that he should be chosen as its first president. A joint committee appointed to study this merger met on March 9, 1912, approved the plan, and submitted recommendations to the Boston and New York organizations for approval. This initial work was done chiefly by Marriott, Hogan and Goldsmith.

I. R. E. held its first meeting at Fayerweather Hall, Columbia University, on May 13, 1912. At this gathering only official business was transacted, chiefly the matter of electing officers to serve until 1913. R. H. Marriott was chosen as president, Fritz Lowenstein vice-president, Emil J. Simon secretary, and E. D. Forbes, treasurer. The Board of Direction included G. W. Pickard, Frank Fay, John V. L. Hogan, Jr., and Lloyd Espenschied, in addition to the elected officers.

Charter members of the Institute were defined as those who had been members of either the Society of Wireless Telegraph Engineers or the Wireless Institute in 1912. The number was less than 50. One of these, G. W. Pickard, was the only "double-jointed" charter member, since he had been associated with both originating societies. By December 5, 1912, the membership had grown to 108.

After about a year, it was decided to incorporate the Society. A meeting to decide details of this move was held at Sweet's Restaurant, in down-town New York, on June 23, 1913. Those members with a more legal mind in the make-up of the Institute, finally drew up Articles of Incorporation and on August 23, 1913, the organization was incorporated under the laws of the State of New York.

In brief, the expressed aims of the new association were:

To advance the art and science of



JOHN V. L. HOGAN
Eighth President, I.R.E.

radio transmission, to publish works of literature, science and art for such purpose, to do all and every act necessary, suitable and proper for the accomplishment of any of the purposes or the attainment of any of the powers herein set forth, either alone or in association with other corporations, firms or individuals, to do every act or acts, thing or things, incidental or appurtenant to or growing out of or connected with the aforesaid science or art, or power or any parts thereof, provided the same be not inconsistent with the laws under which this corporation is organized, or prohibited by the State of New York.

(There are some who insist that patent applications have first place as to complexity and half-talk!)

Before and after incorporation, the Institute held monthly meetings sometimes at Fayerweather Hall, or in the office of Dr. Goldsmith at the College of the City of New York; again at the offices of Mr. Hogan or Mr. Espenschied. From 1914 to 1925, Dr. Goldsmith was host for a great majority of these meetings. This was in accordance with his promise to Bob Marriott when the former returned from a trip to Europe in 1914.



E. F. W. ALEXANDERSON
Ninth President, I.R.E.



FULTON CUTTING
Tenth President, I.R.E.

Dockside, he promised faithfully to give up all other activities and further the cause of I. R. E. "For this", writes Marriott, "he had the money, the ability and the location, so that he could easily live up to this promise, and he most emphatically did."

One of the most important functions of the Institute was to preserve its technical papers, and the remarks made upon them, in published *"Proceedings."* These at first were issued quarterly; by 1916 they were stepped up to bi-monthly production; by 1927 they were printed every month. Dr. Goldsmith was elected editor of the *"Proceedings"* at the beginning, and with rare ability turned out a technical magazine remarkably free from errors, edited to the highest tenets of good taste and appearance.

Rarely does anyone assume such a position of necessity somewhat dictatorial without encountering open or concealed hostility, but Dr. Goldsmith's tact, his admitted fitness for the place, and the excellence of his work, together with the fact that all praise was reflected in the direction of the Institute, have won the approval of all. As expressed by "B. D." in an article published in the May, 1937 issue of *Electronics*—matter from which has been freely borrowed in this enlarged view of the subject—"The fact that the *Pro-*

*ceedings* is the recognized publication in the radio engineering field is in no small measure due to the interest and ability which Dr. Goldsmith has exhibited."

However, a one-man editorial board could not keep up with the rapidly growing publication, so in November, 1928, a multi-personnel Board was established, consisting of A. N. Goldsmith, Chairman; Stuart Ballantine, Ralph R. Batcher, W. G. Cady, Carl Dreher and G. W. Pickard. This Board examined all manuscripts submitted for use in the *"Proceedings"*, and carried on extensive editing work, after a Papers Committee had



JOHN H. MORECROFT
Twelfth President, I.R.E.

examined each offering for technical accuracy.

When I. R. E. was formed, standardization in the radio field was unknown. Symbols, definitions, etc., were concocted and used as personally desired. Coincidentally with its formation, the Institute recognized the necessity of establishing definite standards, and formed a Committee for this purpose. The first report of the Standards Committee was issued in 1913 and published in Vol. 4, Part 4 of the *"Proceedings."* This dealt with definitions, graphical symbols, and the matter of tests and ratings. Subsequent reports were issued on following years.



IRVING LANGMUIR
Eleventh President, I.R.E.

World War I seriously reduced the ranks of the operating personnel of the Institute, and of the membership as well. Membership dropped from 1300 in 1917 to 800 in 1918. But the war's end more than compensated for the loss and I. R. E. looked forward to a renaissance of its activities along the



DR. JOHN H. DILLINGER
Thirteenth President, I.R.E.

standard lines of code transmission and reception, tubes and direction-finding.

However, an entirely new branch of radio's activity came out of World War I, just as advances have arisen due to the conflict just ended. That branch was Broadcasting. Starting with Frank Conrad's amateur station 8XK, KDKA followed as a licensed broadcasting outlet, and soon amateurs were entirely submerged by the b.c.l.'s.

The award of Medals became one of the Institute's most prized procedures. The first to be established was the Medal of Honor, set up in 1917. Two years later Emil J. Simon, a Fellow of the Institute, made a bequest of $10,000, the income from which was to be awarded annually to a person who had made notable contributions in radio science. This tribute is known as the Morris Liebmann Memorial Prize.

# MEMBERSHIP LIST OF THE INSTITUTE OF RADIO ENGINEERS

## As of December 5, 1912

1. D. C. Armor
2. B. S. Benning
3. H. Y. Ballon
4. W. W. Bissing
5. Charles F. Bowen
6. Q. A. Brackett
7. O. C. Brill
8. A. P. Browne
9. Don. G. Burnside
10. S. Cabot
11. J. H. Campbell
12. J. E. Campbell
13. R. Neil Calvert
14. W. W. Chadbourne
15. G. H. Clark
16. T. E. Clark
17. L. Cohen
18. C. H. Collins, Jr.
19. P. B. Collison
20. A. B. Cole
21. Capt. A. S. Cowan
22. E. R. Cram
23. A. M. Curtis
24. James Dages
25. F. C. Davis
26. G. S. Davis
27. Lee de Forest
28. Harold P. Donle
29. J. B. Elenschneider
30. John Engler
31. Lloyd Espenschied
32. Frank Fay
33. Philip Farnsworth
34. E. D. Forbes
35. Edward Gage
36. Harry Gawler
37. A. N. Goldsmith
38. V. F. Greaves
39. W. H. Hale
40. H. E. Hallborg
41. Francis Hart
42. Robert L. Hatfield
43. J. H. Hammond, Jr.
44. W. W. Hanscom
45. W. O. Hensgen
46. Arthur A. Herbert
47. Mr. Hetherington
48. Guy Hill
49. Frank Hinners
50. J. V. L. Hogan, Jr.
51. Comdr. W. S. Hogg
52. Jos. M. Hoffman
53. C. I. Hoppough
54. J. E. Hudson
55. W. S. Hubley
56. Comdr. N. E. Irwin
57. Jos. S. Jones
58. C. Merrill Kelly
59. James C. Koehl
60. C. C. Kolster
61. F. A. KOLSTER
62. F. A. Knowlton
63. F. H. Kroger
64. R. H. Langley
65. J. J. Leary
66. Chas. Lequesne
67. Lawrence Lesh
68. M. Liebman
69. G. H. Lewis
70. Benj. Liebowitz
71. C. D. Lindridge
72. F. Lowenstein
73. W. W. Massie
74. R. H. Marriott
75. E. B. Miessner
76. E. B. Moore
77. H. A. Moore
78. L. G. Pacent
79. A. F. Parkhurst
80. G. B. Pegram
81. G. W. Pickard
82. D. R. Price
83. H. S. Price
84. A. Rau
85. P. C. Rawles
86. Samuel Reber
87. T. Richards
88. O. C. Roos
89. Fred C. Ryan
90. A. E. Seelig
91. Harry Shoemaker
92. J. L. Schemerhorn
93. J. A. Silverman
94. E. J. Simon
95. H. W. Secor
96. A. O. Stevens
97. C. H. Sphar
98. A. Kellog Sloan
99. John Stone Stone
100. E. W. Sundberg
101. Donald Stuart
102. W. D. Terrill
103. R. E. Thompson
104. A. Van Dyck
105. Floyd Vanderpoel
106. R. A. Weagant
107. H. R. Zeaman
108. Ashley C. Zwicker



Members of General Committee, Radio Pioneers Dinner: Left to right: Edward J. Content; R. R. Batcher; Louis G. Pacent; George B. Hoadley.

# THE RADIO CLUB OF AMERICA

THE first meeting of the Radio Club of America was held in the Ansonia Hotel, New York City, on January 2, 1909. The Club was formed by a small group of amateur boy experimenters who originally called it the Junior Wireless Club Ltd. whose president was W. E. D. Stokes, Jr. The club held regular monthly meetings for the discussion of radio topics. Two years later in 1911 it was decided to change the name to Radio Club of America. This meeting, held at the home of Frank King, really marks the birth of the Club. The Officers elected were: President, Frank King; Vice Pres., George Eltz, Jr.; Secretary, George E. Burghard; Treasurer, Ernest V. Amy.

The purpose of the organization as stated in the constitution was "The promotion of cooperation among those interested in scientific investigation in the art of Radio communication."

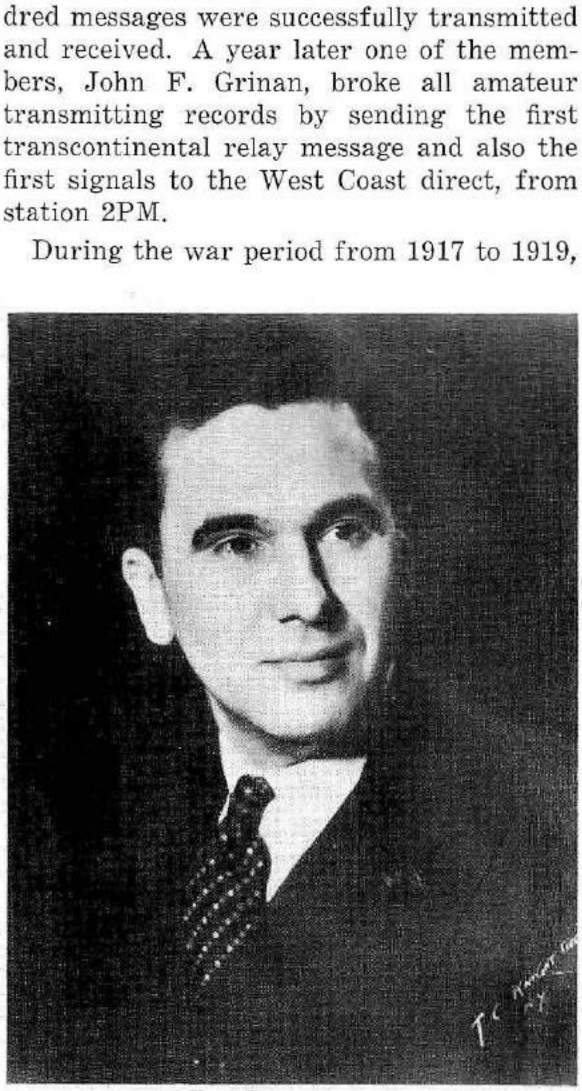
Among the club's early activities was the killing of the Depew Bill in Washington. Realizing that this bill threatened to throttle all private radio experimental activities, the club sent a delegation to Washington which succeeded so well that the bill was killed in committee. These activities are recorded in the Congressional Record of 1910.

In 1912 through the efforts of its members the club issued the first Radio Call Book. It consisted of two blue-printed sheets and contained the names of the then existent amateur radio operators in the vicinity of New York, with their call letters.

Papers were read by members or guests at all monthly meetings. Some of the early readings were: "The Hudson Audion Filament", by Dr. W. G. Hudson; "The Heterodyne Receiving System", by John V. L. Hogan; "Quenched Spark Sets", by Fritz Lowenstein; and "The Regenerative Circuit", by Edwin H. Armstrong.

The club's activities were so many and varied during the ensuing years that space will not permit their recording here. In 1915 a transmitting station was erected and maintained by members in the Ansonia Hotel to handle all traffic for Admiral Fletcher, who made his headquarters there while the U. S. Fleet was in the Hudson River. Several hundred messages were successfully transmitted and received. A year later one of the members, John F. Grinan, broke all amateur transmitting records by sending the first transcontinental relay message and also the first signals to the West Coast direct, from station 2PM.

During the war period from 1917 to 1919,



FRED KLINGENSCHMITT
President, Radio Club of America.

all club activities were suspended, since the membership representation in the armed forces was almost 100 percent. After the war ended a banquet was arranged in honor of Major E. H. Armstrong, who had just returned from France. The object was to do homage to his many achievements, notably the invention of the superheterodyne receiver.

As an aftermath of the war, the U. S. Navy decided in 1919 to fly the Atlantic and designated and equipped three NC boats for

the purpose. Harry Sadenwater, prominent member of the Radio Club, made the trip on the NC1 as radio operator.

In 1921, the club erected an official transmitting station at Greenwich, Conn., in order to enter the transatlantic tests. This station, with call letters 1BCG, became famous as the first transmitter ever to send a message across the Atlantic on short waves with low power. It also broke all records by transmitting messages direct to the West Coast and Catalina Island over land.

The Club always has been active and will continue to be active in all matters pertaining to regulation of radio transmission and reception. In 1922 it was represented on the Hoover Radio committee by Major Armstrong, and in 1923 it sent a delegation to remonstrate with President Coolidge about the interference caused by naval stations to broadcasting. Professor Pupin, who was ever a great friend of radio, protested against the White-Dill Bill at the 1926 banquet when he was guest of Honor, with the warning, "Noli me tangere", meaning "hands off!" This bill proposed a Radio Commission and was later passed over opposition. The club then sent a wire to the President recommending its well-known member, Robert H. Marriott, as a member of the commission.

The annual Banquet is one of the few social activities of the club aside from the monthly meetings, and has been held every year with the exception of the periods of war. On December 19, 1935, the club presented Major Armstrong with a scroll dedicating the Armstrong Medal in recognition of his achievements in the radio art. The medal is presented from time to time to a member of the club who has made an important contribution to the radio art and science. It is presented on the occasion of the annual banquet. Among the medalists to date are Dr. Harold H. Beverage, Professor Alan Hazeltine, and Harry W. Houck.

Many important discoveries have been presented before the membership in the past few years. Notable among these was the demonstration by Armstrong of his system of frequency modulation in 1939.

The Radio Club of America this year holds its thirty-sixth anniversary banquet with the proud distinction of being the oldest radio club in existence today.

*Contributed by George Burghard*

# NEW YORK—THE HUB OF RADIO ACTIVITY

ALTHOUGH Elwell, de Forest and Fuller in their active years did a few tricks with wireless on the West Coast, and spasmodic efforts were reported now and then in non-oceanic cities, such as Chicago, Cleveland and Washington, no city has ever compared with New York as the originating point of radio activities.

The Wireless Institute, Bob Marriott's pet, used to hold its meetings at 42 Broadway, New York. When he merged with Stone's Society to form the Institute of Radio Engineers, the incorporation took place at Sweet's Restaurant at 2 Fulton Street, and many of its subsequent meetings were held there and at Fusco's Restaurant, 18 Beaver Street. De Forest stations graced 17 State Street, Stone Street, and 66 Broadway; the Wireless Specialty Company had a New York office at 81 New Street and later at 149 Broadway. The Wireless Improvement Company was also a tenant of 81 New Street. Dubilier odorized the air with his condenser-impregnating compound from 217 Center Street. The Telefunken Company held out at 111 Broadway, where it had a tower and R. Pfund. The Atlantic Communication Company was at 47 West Street. Colonel John Firth had his latter-day office at 25 Beaver Street, where this Souvenir Program was fabricated. The New York Herald station, OHX, was in the Barge Office at the Battery, within a stone's throw of the present Wireless Operators' Monument. The Marconi Wireless Telegraph Company of America was located at many successive sites: Bridge Street, 37 Walter Street, 125 Front Street, 29 Cliff Street, 27 Elm Street, 27 William Street, and lastly at 66 Broad Street, and 326 Broadway. The last-named location also housed the International Radio Telegraph Co., grandchild of Fessenden.




William J. McGonigle
President, Veteran Wireless Operators Association.

# VETERAN WIRELESS OPERATORS ASSOCIATION

THE Veteran Wireless Operator's Association stems back to the very first wireless operators' fraternity, founded by William S. Fitzpatrick in 1912 among the operators of the de Forest company of that date, and later of the United Wireless Telegraph Company. Its name was the "OWLS", which when spelled backward formed the initials of the "Society of Licensed Wireless Operators."

At first, the organization was purely fraternal, but soon it began to be active in urging better salaries and working conditions for the men. The companies concerned "clamped down." A year or two later it reappeared as the American Wireless Telegraphers Association, headed by Benjamin Beckerman. This, too, lasted only a few years.

In 1918 the most flourishing of these early associations was formed. It was called the United Radio Telegraphers Association, with Ben Beckerman as president, and Sam Schneider, Peter Podell, and Bill Fitzpatrick as associated officers. This was not exactly an operators' union, but it worked somewhat along those lines. However, lacking a place to meet, it promised "to be good" if the Marconi Company would donate a clubhouse. This was done by Mr. E. J. Nally, and the name of the association changed to the Marconi Radio Telegraphers Association.

Old-time members of these short-lived societies still desired to found another association, this time a permanent one. Peter Podell, Bill Fitzpatrick, Sam Schneider, and Gilson Willetts severally and individually yearned for this, but did nothing actively about it until all at once the last named leader, aided by his dynamic right-hand man, Jim Moresca—the two were then handling Gernsback's broadcasting station WRNY—held conferences with the other old-timers named, and as a result the Veteran Wireless Operators Association was formed. Meetings were held first at WRNY, but on Nov. 23, 1925, the first of many hotel meetings was held, the initial site being the Astor. Little by little the idea grew, and on June 16, 1926, the first annual reunion on a large scale, titled the "Annual Cruise", took place. This has been repeated every year since, usually in February.

Late in 1928 the V. W .O. A. was incorporated under the laws of the State of Dela-

ware. Its incorporators were J. F. J. Maher, its first president; the late Arthur Coleman, and G. H. Clark. Its aims, as set forth in the first handbook and list of members, dated January 1, 1929, are, briefly, to foster an esprit de corps among wireless operators, to afford opportunity for social intercourse, to recognize meritorious service by operators, and to acquaint the public with the work done by operators, and with their traditions and ideals.

The list of presidents is not long. It consists of Gilson Willetts (temporary); the late W. S. Fitzpatrick (temporary); William Gill; J. F. J. Maher (3 terms); the late J. B. Duffy; Fred Muller (4 terms); G. H. Clark (two terms) and W. J. McGonigle, nine terms to date. Herbert Hoover and Senatore Guglielmo Marconi have been Honorary Presidents of the Association, and Dr. Lee de Forest fills that role today.




Obverse of Marconi Memorial Medal, Veteran Wireless Operators Assn.



G. Marconi

# THE TRANSATLANTIC TIMES.

VOLUME I. NUMBER I.

THE TRANSATLANTIC TIMES

Published on board the "*ST PAUL,*" at Sea, *en route* for England, November 15th, 1899.

One Dollar per Copy in aid of the Seamen's Fund.

Mr. W W Bradfield, Editor in-Chief. Mr T Bowden, Assistant Editor. Miss J B Holman, Treasurer. Mr H H McClure, Managing Editor.

Through the courtesy of Mr G Marconi, the passengers on board the "St Paul," are accorded a rare privilege, that of receiving news several hours before landing. Mr Marconi and his assistants have arranged for work the apparatus used in reporting the Yacht Race in New York, and are now receiving dispatches from their station at the Needles. War news from South Africa and home messages from London and Paris are being received. The most important dispatches are published on the opposite page. As all know, this is the first time that such a venture as this has been undertaken. A Newspaper published at Sea with Wireless Telegraph messages received and printed on a ship going twenty knots an hour!

This is the 52nd voyage eastward of the "St Paul." There are 375 passengers on board, counting the distinguished and extinguished

The days' runs have been as follows ;—

| | |
|---|---|
| Nov. 9th | 435 |
| „ 10th | 436 |
| „ 11th | 425 |
| „ 12th | 424 |
| „ 13th | 431 |
| „ 14th | 414 |
| „ 15th | 412 |

97 miles to Needles at 12 o'clock, Nov. 15th.

BULLETINS

1.50 p m. . . . — . First Signal received, 66 miles from Needles

2-40 "Was that you "St. Paul"? 50 miles from Needles.

2-50 Hurrah! Welcome Home! Where are you?

3-30 40 miles, Ladysmith, Kimberley and Mafeking holding out well. No big battle. 15,000 men recently landed.

3-40 "At Ladysmith no more killed. Bombardment at Kimberley effected the destruction of ONE TIN POT. It was auctioned for £200 It is felt that period of anxiety and strain is over, and that our turn has come."

4.00 Sorry to say the U. S. A. Cruiser "Charleston" is lost. All hands saved

The thanks of the Editors are given to Captain Jamison, who grants us the privelege of this issue.

**Fac-simile of the First Newspaper Ever Published Aboard Ship Containing Wireless News from Shore. Marconi Signature authenticates the Original Now Owned by Mr. John Bottomley, Secretary of the Marconi Wireless Telegraph Co., of America.**

First newspaper published on shipboard with news furnished by wireless telegraphy, 1899. Marconi's Wireless Telegraph Co., Ltd.

# The Operators' Monument, Battery Park, N. Y.

BY THE side of the Barge Office, at the Battery, on the lower tip of Manhattan, stands a small monument, flanked by a drinking fountain. It has been viewed by countless thousands since its dedication on May 12, 1915.

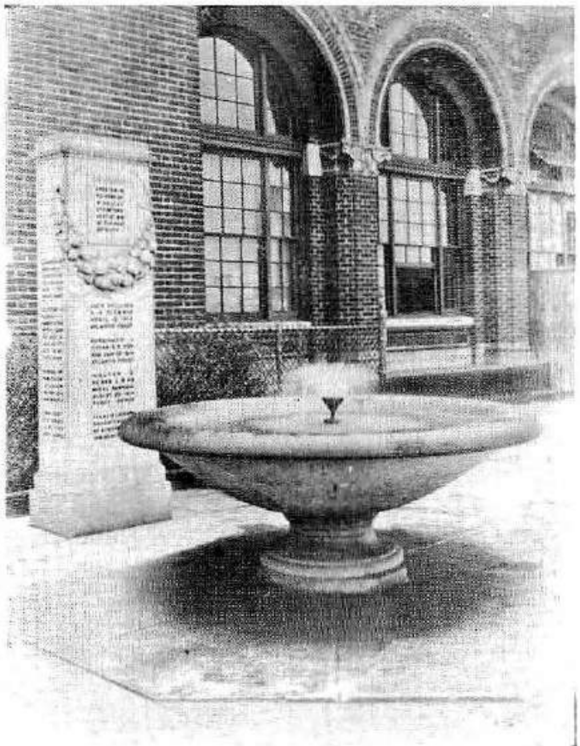
The monument is the American equivalent of a similar memorial, erected in Godalming, England, in memory of Jack Philips, the wireless operator who stuck to his post and died in his devotion to duty, on the sinking of the *S.S. Titanic*, April 15, 1912.

The American monument was originally planned for the same purpose as the memorial in Britain, but later it was decided to extend it to include all operators who might give their lives in saving others by means of wireless. The first subscription was from the *New York Times*, for $100, and soon thereafter, the Marconi Wireless Telegraph Company of America donated $500.

Memorial services have been held on each succeeding Memorial Day, at first under the auspices of the Marconi Company, and later by the Veteran Wireless Operators Association. If some heroic deed has occurred during the previous year, a bronze plaque with the hero's name is placed upon the monument shaft and the services are especially dedicated to his memory. The name of George Eccles, who died on the sinking of the *S.S. Ohio*, in 1909, heads the list of heroes.

Funds for the maintenance of the monument, for adding bronze memorial notices when further deeds of heroism occurred, and for memorial wreaths and other appropriate symbols of appreciation were first disbursed by a committee headed by E. B. Pillsbury. At his death, the late J. B. Duffy administered the money. Now it is jointly held by a Monument Committee, stemming from the original controllers and the Veteran Wireless Operators Association.

Within V. W. O. A.'s domain there has been for some time a somewhat similar Marconi Memorial Fund of which Brigadier General David Sarnoff is Chairman. Its purpose is the erection of a suitable memorial to the Father of Wireless. The Committee has acquired some valuable material from the New York World's Fair, including a bas-relief in black marble of the Senatore. Recently, the merging of these funds has been discussed with the idea of seeking further aid to erect a really fitting memorial to those who have given their lives that wireless might save others as well as to the man who made this life saving possible.



Operators' Monument, Battery Park, New York.

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WHEN RADIO MEN WERE POETS

To the honorable Editor-in-Chief
Who edits the grief
In the little sheaf
Of paper leaf
We dedicate this dope beneath
And bespeak in the "Service Magazine"
A place where it can well be seen.

G. C. McCarty from the "H. T. Scott"
Says holidays are tommyrot,
And busted flat has returned to battle
With radiograms on the "City of Seattle."
etc. etc. etc.

C. B. Cooper
Marconi Service Magazine, April, 1914




Cover pages of official booklets issued by the pioneer wireless societies of the U. S. A.

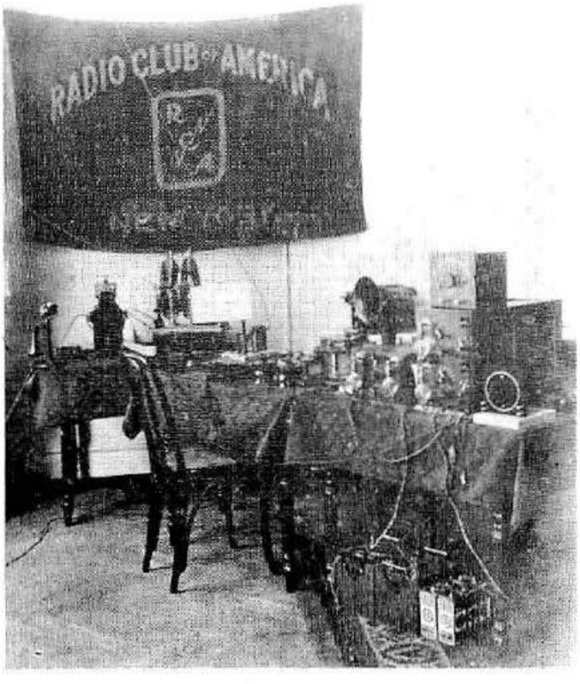
# AMATEUR RADIO AND THE A.R.R.L.

AMATEUR wireless clubs came into existence almost as soon as commercial stations appeared in this country. Later search may uncover the very first of these associations, but at the present moment it must suffice to note that by 1909, over ninety such clubs were listed in Hugo Gernsback's *Wireless Blue Book.*

These were all individual clubs. Despite the American fondness for unions, from the earliest days down to the present these clubs have come and gone, retaining through their existence, whether ephemeral or long, their own rights. However, an entirely separate organization, devoted to the betterment of amateur radio in general was formed, and with this any club could be affiliated, or it might remain as aloof as it pleased. Nevertheless, this association, the American Radio Relay League, has continued to look after the interests of amateur radio as a whole. It publishes one of the most technical radio monthlies extant on the subject of amateur radio, and, in addition, a Handbook which cannot be bettered by any textbook for accuracy, clarity and coverage. To the printed pages of the monthly magazine, any club or any individual amateur may subscribe, but there is one phase in which the individual must bow to A.R.R.L.'s power, willy-nilly—he has to accept the betterments in allocations of the radio spectrum which have been fought for, and won, by A.R.R.L.'s unselfish contests with Government and "the interests". Therefore, in any recital of Amateurs' Progress, the parallel history of the A.R.R.L. must be interwoven.



Amateur station "IUW" of A. R. Nilson, Providence, R. I., 1912.



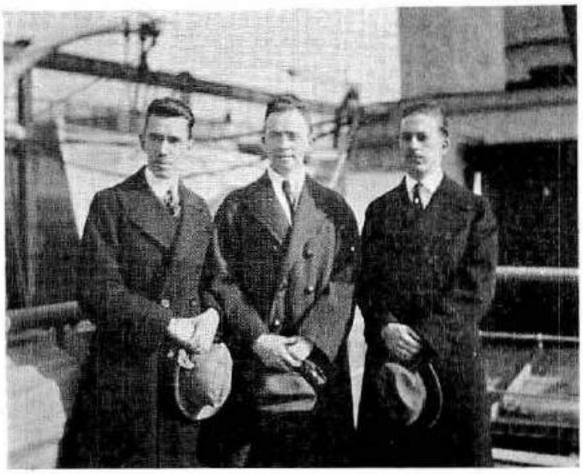

Radio Club of America headquarters, Hotel Ansonia; Hudson Fulton Centennial Celebration.

The first amateur in the world was young Guglielmo Marconi, who wheedled an unrecorded number of Italian lire from his rather unwilling father for the crude spark-coils of the day, for wire and files and glass tubing. His achievements, first between tables in his attic and later on his father's well-kept lawn, smacked of the amateur if anything could be thus called. Hertz, on the other hand, was doing scientific work; Popoff was the meteorologist, trying to copy static instead of eliminating it; others were likewise of high intellectual status, but young Guglielmo was purely and simply the kid trying to send messages from point A to point B.

Little by little the amateur craze grew. "Craze" was the correct word, as far as the weird set-ups concocted by the laws were concerned. Also as to the feelings of the




Covers of early catalogues listing
amateur wireless apparatus.



"Seeing Godley Off." Left to right: K. B. Warner; Paul Godley; Fred Schnell.

Navy and the commercial operators who had to listen to the rock-crushers when urgent messages were in the air. Everyone "chewed the fat". Standard procedure was to call another station, ask him "How is my spark?" (and not in Q-code at that), and then proceed to do the same thing all over again with as many other stations as could be reached.

"Plain aerial" was standard. A famous set of this era was the 100-mile wireless set of the Electro Importing Co., with an open core transformer, recommended for use with interrupter or 60 cycle A.C.

In those early days, the amateur in many cases, had more money than some of the commercial companies. Moreover, both classes of wireless workers used apparatus almost equally crude. It is rather an unflattering commentary on the state of the art as it existed around 1903-1910, that the commercial concerns had to give jobs to the amateurs with the biggest sets around New York, in order to get a chance to receive their own messages.

One of the early amateur clubs was the Junior Wireless Club, Ltd., formed in New York in 1909, under the leadership of W. E. D. Stokes, Jr. George Eltz, Ernest Amy, Frank King, George Burghard were among the members. A certain Dr. Besser, call HB, was known as the Queen of the Glue Factory, because he was unable to send over five words a minute. This association finally changed its name to the Radio Club of America. Its trend today has veered away somewhat from the amateur line which was its admitted starting point.

There were many other wireless clubs, in the principal cities of the United States, around that time. It was in one of them, the Hartford Radio Club, that the idea of interconnecting amateurs as a relaying organization, was born. This idea originated with Hiram Percy Maxim, famous as a pioneer automobile inventor and the inventor of the Maxim silencer. It was he who introduced the idea of one station forwarding messages to another along a specified route, instead of "every station for himself".

In January, 1914, Maxim—who had his own amateur station, 1WH, at his home in Hartford, and who later listed himself as able to copy 20 w.p.m.,—called a meeting of the Radio Club of Hartford, and explained to them the tremendous advantages to be gained by forming definite methods of routing, and relaying messages along those lines. Apparently a traffic manager at heart, he sold his scheme to the members, and by May, 1914, a committee had laid out a plan, which soon was being introduced to all amateurs within reach.

In June, 1914, the Club relayed its first message from Hartford to Buffalo. From that time on, the growth of the idea and the success of "routes" were scarcely short of phenomenal. The League was incorporated under the laws of the State of Connecticut in January, 1915. By that time it had a Call Book of its own, with 400 stations listed in the United States and Canada. Copies of this edition, bearing the date of October, 1914, are now collectors' items. Glancing through the yellowing pages, one notes such well-known names as Harry R. Cheetham, D. A. Lewis, F. Clifford Estey, Eugene S. Pearl, Charles E. Apgar, Edward T. Dickey, Orrin E. Dunlap, Jr., F. B. Chambers, Malcolm Ferris, Charles Stewart, and many others who later rose to important positions in the various fields of communication-without-wires.

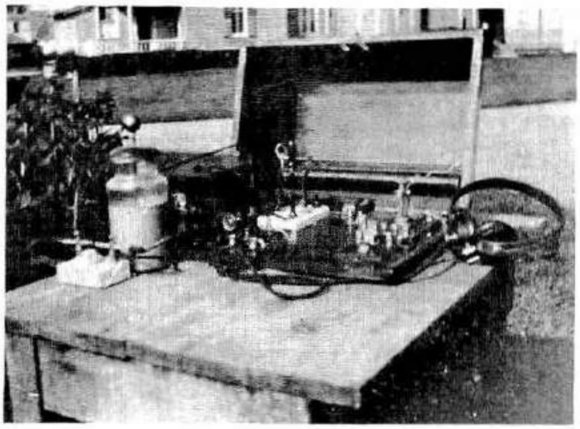
Much of this mushroom growth was due to the fact that two far-sighted men early saw the need of a printed organ to spread the amateur idea and to report progress. These men were Mr. Maxim and his fellow Hartfordian, Clarence D. Tuska, the latter a

college student in his late teens. This magazine, called *"QST"*, made its bow to the etheric world in December, 1915. The two founders assumed the original expense and called for subscriptions. By the beginning of the year, the A.R.R.L. was "on its own", having parted company with the Radio Club of Hartford and become national in scope.

A.R.R.L.'s first nation-wide relay took place early in 1917 between Los Angeles, Denver, Jefferson City, Albany, and Hartford. Relaying was a reality. Then came the war! All amateur stations were shut down, and most of the members joined the armed forces. There they contributed their rare gift of experience in communications to the Army and Navy radio services. At the same time, the amateurs were gaining experience in both theory and practice through their operation of Signal Corps and Navy radio stations.

When the war ended, the A.R.R.L. Board voted to reorganize the League, and in June, 1919, it bought *QST* from its original two owners. Lieut. K. B. Warner was elected secretary, later becoming editor and business manager. Everyone was set to go, using headphones which had been "loaned" to them by Army and Navy during the War, to hook up audions regeneratively and add amplifiers to them. But Navy Secretary Daniels blocked all such moves. Finally, though the efforts of A.R.R.L. and Mr. Maxim, the lid was lifted, and the "big boom" started. *QST* for May, 1934, recalls these days in the following poetic language:

> "Gangway for King Spark! Glorious old sparks! Night after night they boomed and echoed down the air lanes. Night after night the mighty chorus swelled, by ones, by twos, by dozens, until the crescendo thunder of their Stentor bellowings shook and jarred the very universe. A thousand voices clamored for attention. Five hundred cycle's high, metallic ring. The resonant organ basso of the sixty-cycle "sync". The harsh, resounding snarl of the straight rotary. Good-natured sparks that drawled lazily and ended in a throaty chuckle as the gap coasted downhill for the sign-off."



Amateur wireless station of Frank King, "FK", 1907.

"Spark forever!" was the slogan of the amateurs in those days. With VT reception, the spark seemeo to be ideal. But a single event changed the tide. That was the holding of A.R.R.L.'s second transatlantic test, in December, 1921, when A.R.R.L. sent Paul Godley, foremost expert on receiving in America and universally known as "Paragon Paul", to England. Setting up his apparatus on a bleak Ardrossan moor, at the very edge of the sea, he picked up thirty American stations. But then came the amazing news: *more than two-thirds of the recorded stations were c.w.!* That was enough. In a year, most spark sets were in the scrap heap; so rapid was the changeover that in three years spark had sunk to utter oblivion. King VT rode the waves supreme.

In November, 1923, Fred Schnell at 1MO worked with Leon Deloy, 8AD, in Nice, France, the first two-way communication over the Atlantic. Deloy's "rough, throaty gurgle" filled the fones, the account says, referring to the 25-cycle source of his power. Most significant of all, this work was done on 110 meters. "200 Meters and Down" had descended half-way! On December of this same year, the first QSO between England and America occurred, with K. B. Warner on the U. S. end.

Such, briefly, has been the history of amateur Radio, and especially of the American Radio Relay League, perhaps the most aggressive of all American radio organizations, certainly the most successful in convincing officialdom of what was right and what would be best for the art.

# HISTORY OF RADIO
## Down to 1925

•

### Brief but Comprehensive—Including Some Little Known Background and Highlights

## PRELUDE

### *Things that went before, in the Victorian age*

INSTRUMENTALITIES:

Electromechanical devices; the Leyden jar, the Ruhmkorf coil, spark discharges in air and gaseous tubes.

SERVICES:

Telegraphy, early telephony, and the beginnings of electric power.

SOME PREMATURE PROPOSALS:

**1850 - 90** — Induction "wireless" experiments by Highton, Loomis, Trowbridge, Dolbear, etc.

**1870**—C. F. Varley plans superimposing a-c telegraph channel upon d-c, detecting by means of polarized Geissler tube, British patent No. 1044.

**1880** — Bell's photophone (light beam) telephone, christened the radiophone by Mercadier.

**1890's**—Attempts at multiplex telephony by Hutin and Leblanc, Pupin, John Stone Stone, using oscillators and h.f. alternators.

ACCRETION OF FUNDAMENTAL KNOWLEDGE:

Conception of electrical action at a distance on the basis of a finite time of propagation in a manner analogous to light, starting with Faraday, Gauss, Weber and Kirchhoff, and maturing in the 1860's and 1870's in Maxwell's equations which identified light as electromagnetic waves and indicated the possibility of longer waves.

That the spark discharge from the Leyden jar is oscillatory, suggested as early as 1827 by Felix Savary, followed by Joseph Henry and Helmholtz. Experimental verification 1850's-60's by Fedderson and Paalzow. In 1883 Fitzgerald indicated Leyden jar discharges should emit Maxwellian radiation.



OLIVER HEAVISIDE

## BIRTH OF RADIO IN THE PHYSICAL LABORATORY

**1887-88** — Hertz generates and detects high-frequency electromagnetic waves. Studies their propagation over wires and through space; demonstrates optical properties of space waves: reflection, refraction, polarization.

**1890's**—Further scientific study of Hertzian waves by Righi, Bjerknes, Lecher (standing waves on wires) Lodge, Drude, et al.

Foreshadowing of the application of Hertzian waves to telegraphy, in the *Fortnightly Review* for February 1892, by Crookes.



FIG. 2.—TESLA CENTRAL POWER PLANT AND TRANSMITTING TOWER FOR WORLD TELEGRAPHY, WARDENCLYFFE, LONG ISLAND, N. Y.

*(Tower is a pyramid having eight sides; smallest dimensions acr ase, 29 meters; height, 47 meters; total height from ground to t 7 meters; cupola on top, 20 meters diameter.)* SRM 6-22

Early detectors:

The minute spark gap of Hertz.

Microphonic contact and galvanometer by Fitzgerald.

Gaseous trigger tube—Zehnder.

Filings coherer—Branley.

Automatic decoherer; Lodge, Marconi.

Magnetic; Rutherford.

Use by Popoff of vertical antenna-ground and coherer for registering lightning flashes.

**1891-92**—Nikola Tesla demonstrates high-frequency power effects.

## BEGINNING OF WIRELESS TELEGRAPHY

**1895 - 1905** — Marconi applies Hertzian waves to wireless telegraphy using a vertical antenna-ground radiator and absorber, producing vertically polarized waves which could be readily increased in length to avoid the limitation of line of sight propagation.

Other inventors, as distinct from the earlier scientists; Slaby, Fessenden, Stone, de Forest.

The Marconi Company is formed in England, and the new art is taken up by Companies in other countries, such as Slaby-Arco and Telefunken in Germany, Ducretet in France, de Forest, Stone and Fessenden in the U. S. A.

**1900-10**—First application of wireless to ships at sea, earliest to British ships by virtue of that country's natural interest in navigation.

The sparks crackle at sea; wireless comes to the rescue, CQD, later SOS.

**1909-12**—*S.S. Republic* sinks in collision; sensational rescue of passengers by wireless; followed by another striking demonstration in the *Titanic* disaster.

**1910-12**—Wireless companies capitalized in the millions; watered stock unloaded on the public by unscrupulous promoters, some of whom go to jail.

WIRELESS BECOMES INTERNATIONAL:

The necessity for intercommunication on the high seas leads to international agreements covering:

1. Standardization of calling frequency (600 meters, 500 kc) and of traffic procedure.



SENATORE GUGLIELMO MARCONI

2. Technical provisions for minimizing interference; made fully possible only after the attainment of continuous wave transmission.

First international conference at Berlin 1903 and 1906; then at London 1912, which led to the licensing of radio operators and transmitting stations.

OVERSEAS WORKING:

**1901**—Newfoundland kite reception.

## SOME HIGH SPOTS OF THE EARLY LITERATURE

**1873**—Maxwell's "Treatise on Electricity and Magnetism."

**1892**—Hertz's ". . . Ausbreitung der Elektrischen Craft." Translation into English, 1900, by Jones, entitled "Electric Waves."

**1897**—Lodge's "Signaling Across Space Without Wires". Slaby's "Die Funkentelegraphie."

**1898**—Righi's "Die Optik der Elektrischen Schwingungen."

**1905** — Zenneck's "Elektromagnetische Schwingungen und drahtlose Telegraphie."

**1906**—Fleming's "The Principles of Electric Wave Telegraphy."

**1908**—"Jahrbuch der drahtlose Telegraph & Telephonie", started.

**1909**—Robinson's "Manual of Radiotelegraphy", and succeeding issues.

**1913**—I. R. E. Proceedings begun.

**1913**—Yearbook of Wireless Telegraphy begun by Marconi Co. Continued to 1925.



J. R. ("Jack") Binns, heroic wireless operator of the *S.S. Republic*, rammed by the *S.S. Florida* on June 23, 1909. The apparatus shown was not the type used on that occasion.



Marconi spark installation on *S.S. Minnehaha*, 1904. Note tape, coherer, 10-inch coil and the tuning coil in aerial.

## FREQUENCY DISCRIMINATION

**1870**—Beginning of the idea of superimposing messages on different frequencies; an a-c channel superimposed upon a d-c channel in wire telegraphy, disclosed in C. F. Varley's British patent No. 1044 of 1870. A-c channel taken off through a condenser, d-c channel through an inductance; rudimentary filter circuit.

**1870's-80's**—Simultaneous telegraph-telephone tests by Elisha Gray; successful system by Van Rysselberghe.

**1887-88**—Use of electrical resonance by Hertz; first resonance curve.

**1890-95**—Early attempts at superimposing a plurality of channels for multiplex wire telephony, already mentioned.

**1900-1905**—Coupled circuit wireless technique for greater persistence of waves and greater selectance: Lodge, Marconi, John Stone Stone, Fessenden.

**1900-1915**—Recognition by G. A. Campbell of the cutoff characteristic of a periodically loaded line. Derivation about 1910 of the artificial line; proportioning to give bandpass or high-pass or low-pass band characteristic.

The accumulation of knowledge of electromagnetic wave propagation over circuits, starting with Kirchhoff's network laws, and running through the whole rise of knowledge associated with Maxwell and Heaviside, and concerned practically with attenuation, phase shift, impedance matching, band characteristics, has rolled up a great circuit network theory and technique.

## TRANSITION TO CONTINUOUS-WAVE OPERATION

**Early 1900's**—At first some confusion of thought: For purposes of radiation is it necessary to have a very sudden reversal of electric force corresponding to a frequency of a million?

An authority, J. A. Fleming, thought so, in a paper presented at the International Electrical Congress meeting at the St. Louis Exposition, 1904.

Sustained waves needed for: Greater selectivity; attainment of radiotelephony.

**1905-15**—Trend to longer distances dictated more persistent and more powerful waves.

Spark discharges of higher spark frequency; rotary, timed spark, quenched, compressed air, attenuated air gaps.

Discharges of an arc character: Elihu Thomson's arc, 1893; Duddell's musical arc, 1900; Poulsen, 1903. Poulsen arc the first generally used high power CW transmitter.

In the laboratory, mercury vapor arcs, Peter Cooper Hewitt, 1903-4; Vreeland's oscillator; not high enough in frequency.

Machine alternators creep upward in frequency as radio frequencies come down.

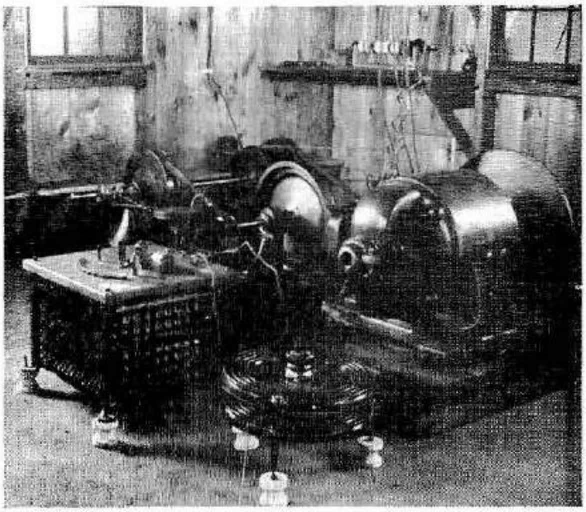
1903-6—10,000 to 50,000 cycle machines, 1 kw, developed by Steinmetz and by Alexanderson of G.E., for Fessenden.

1912-15—High power alternator and magnetic amplifier started for transoceanic operation, by Alexanderson, designed by Alexanderson.

**1906-12**—Some early attempts at radiotelephony, by Fessenden and de Forest in America, by Poulsen, Majorana, Vanni, Ruhmer in Europe. Major Squries' experiments in high frequency wire transmission using alternator and audio-detector, 1911.

## EARLY ORIGIN OF ELECTRONICS

**1850-1900**—The origin of the vacuum tube and electronics in general lies deep in the experimental physics of the last century. Curiosity as to the nature of the electrical discharge in a partially evacuated tube started in the 1700's; and progress ensued with the development of improved vacuum



Fessenden alternator, 60,000 cycles; ¼ kw. output. Installed at Brant Rock (Mass.) Station, "BO."

pumps and continued experimental study of the flow of electricity through attenuated gases.

Pioneer experimentalists: Faraday who named the negative terminal the cathode; Plückner, Geissler, Goldstein who gave the name cathode rays, Hittorf and Crookes, who first seriously studied with rays.

In the 1880's Edison discovers filament-plate conduction in an incandescent lamp, but the phenomenon is not understood. Study of thermionic emission by Elster and Geitel, Wehnelt and Richardson into the 1900's.

Pursuit of the electron, its measurement and identification, participated in by many, such as Schuster, Weichert, Lenard, Kaufmann, Stark, and notably J. J. Thomson, about 1900.

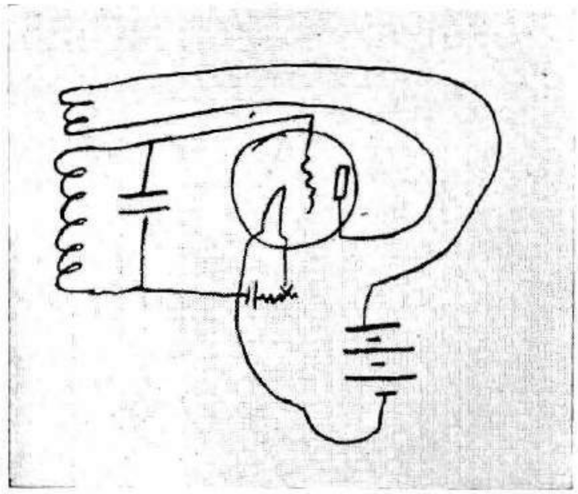
The discovery of X-rays by Roentgen in 1895, and the discovery of radio activity by Becquerel in 1896 greatly stimulated interest in vacuum tubes and electron emission and the constitution of matter.

**1900-1912**—Early beginnings of the practical vacuum tube:

The Braun cathode ray tube, giving a visible pattern, the oscilloscope of television.

Mercury-vapor amplifying tubes by Peter Cooper Hewitt, H. D. Arnold and others.

Two-element rectifier tubes by Wehnelt and Fleming.



First recorded notes by deForest and his engineers concerning the audion.

Adaptation of the Braun tube as a deflection-beam amplifier, by von Lieben.

The grid-controlled tube or audion of de Forest; first a radio detector, 1906-07; adapted to an *amplifier* in 1912; and later to an *oscillator;* when perfected as a high vacuum tube, became the great electronic instrument of electric communications.

CLASSICAL TEXTBOOKS:

**1902**—Stark's "Die Elektrizitate in Gasen"

**1903**—J. J. Thomson's "Conduction of Electricity through Gases"

**1904**—Soddy's "Radio-Activity: From the Standpoint of the Disintegration Theory"

Rutherford's "Radio-Activity"

**1916**—Richardson's "Emission of Electricity from Hot Bodies"

## USHERING IN THE ELECTRONIC AGE OF RADIO

**1912-13**—Production of the high vacuum amplifying tube, as an improvement on de Forest, using the findings of pure science, almost simultaneously in two great industrial laboratories, by H. D. Arnold of the telephone company, and Irving Langmuir of G.E.

The vacuum tube then quickly graduated from the realm of a rather mysterious and unreliable device to one of great utility capable of being engineered.

**1912-15**—The vacuum tube's characteristics come to be known, and the harnessing of it as a circuit element established.

The amplifying tube becomes:

An oscillator; de Forest, Armstrong, Meissner, Round, Colpitts, Hartley.

A modulator; Alexanderson, Colpitts, van der Bijil, Heising.

A power amplifier for transmission; Arnold, Langmuir, van der Bijil.

**1914-15**—Devising of the first all-vacuum tube radio and carrier current telephone systems, resulting in the solution of the problem of high frequency telephony for both radio and wires—in the Bell System's laboratories and those of the G. E.

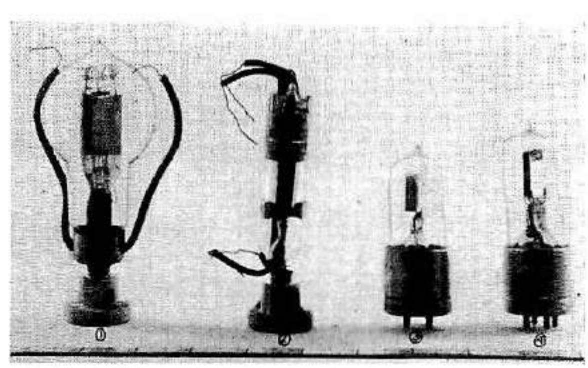
**1915**—First spanning of the oceans by the human voice, by experimental vacuum tube radiotelephony, by the telephone company with the co-operation of the U. S. Navy, at Arlington, Va. (NAA).

**1916**—Development of first experimental vacuum tube radiotelephone systems for the Navy by G. E. and the W. E. Co.

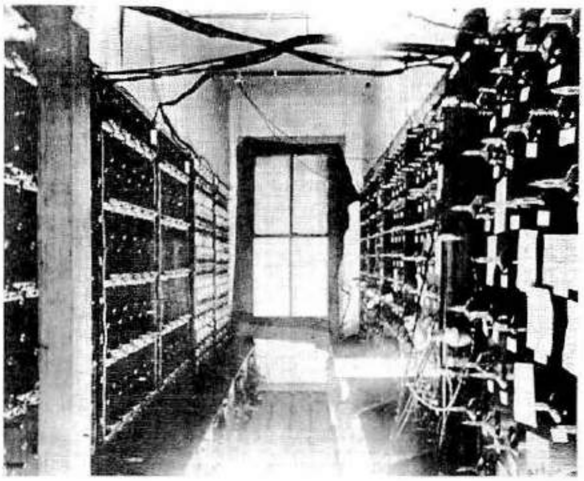
Publication by G. E. of circuits on production from vacuum tube oscillators of higher frequencies, up to 15 megacycles.

**1913-20**—Some contributions to the knowledge of the vacuum tube and transmission circuits:

Mastering of knowledge of the operation of the de Forest grid audion and the problem of increasing the electron emission leading to the perfection of the high vacuum tube,



Early deForest audions. On the left is the famous "green for grid, red for plate" type. These were the colors of the sleeving over the wires leading to these elements.



Racks of tubes arranged in parallel as used during the first radiotelephone conversation across the Atlantic in 1915, from Navy station NAA.

by Arnold and Langmuir in industrial laboratories, 1913.

First published elucidation of the operation of the audion as a detector by Armstrong, 1914.

Expression of the value of plate current in terms of plate and grid voltage, and the concept of the amplification factor *mu*, and treatment of the vacuum tube as part of a circuit network, by van der Bijil, Nichols and Carson, published in 1918-1920.

Recognition of the band nature of a modulated carrier, starting with Campbell and his band filter, and maturing in Carson's analysis of carrier and sidebands and his invention of single sideband transmission, 1915.

**1917-18**—War Developments:

First production of vacuum tubes in quantity, both coated filament and tungsten filament types, by W. E. Co. and G. E.

Development of small radiotelephone sets for submarine chasers and airplanes, representing beginning of radiotelephones for small boats and for aviation. (CW 936).

## RENEWAL OF ELECTRONIC RADIO FOR CIVIL PURPOSES

**1919-22**—Development and field testing of vacuum tube radiotelephone and telegraph systems for marine use.

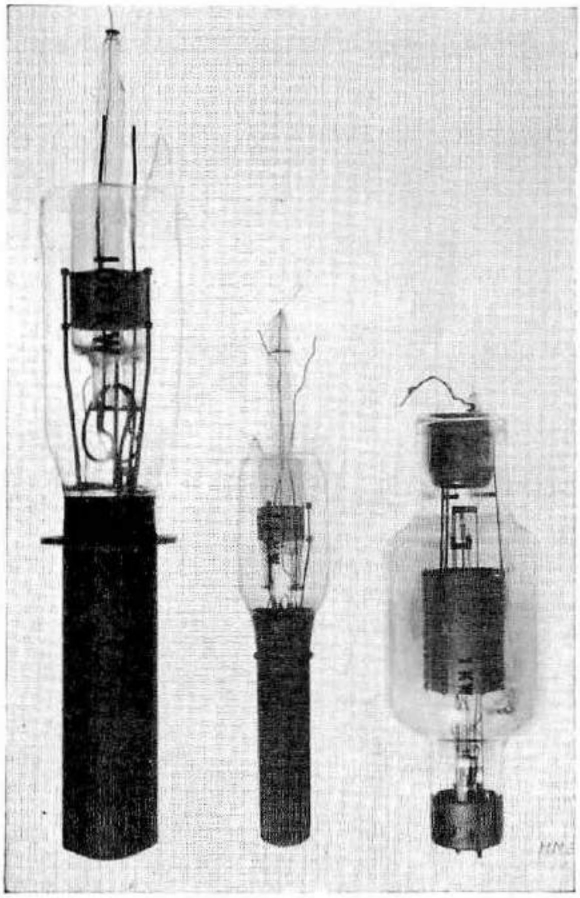
First radiotelephone system for public service, between Catalina Island and the mainland. Beginning of development of privacy systems.

The piezo-electric crystal oscillator, started during the war by Nicolson, is devised by Prof. Cady in quartz crystal form for high frequency stability and selectivity, due to become the basis of radio frequency control.

The interleaving and conflicting patent situation that had grown up between the telephone company and the G. E. Co. was relieved by a cross-licensing agreement, whereby each was free to develop in its field.

Development of the water-cooled power tube in the telephone company's laboratories led in 1922 to the undertaking of transatlantic radiotelephony on a long-wave basis from the RCA station at Rocky Point, L. I.

The spreading of vacuum tube knowledge during the war to an army of young men led in the postwar period to enlarged interest in radio, and as radiotelephone transmit-



Water-cooled transmitting tubes, Circa 1922. Types shown are 1, 10 and 100 kw.

ting experiments were renewed, the nucleus of an audience was provided by thousands of amateurs interested in the technique and seeking entertainment in the air.

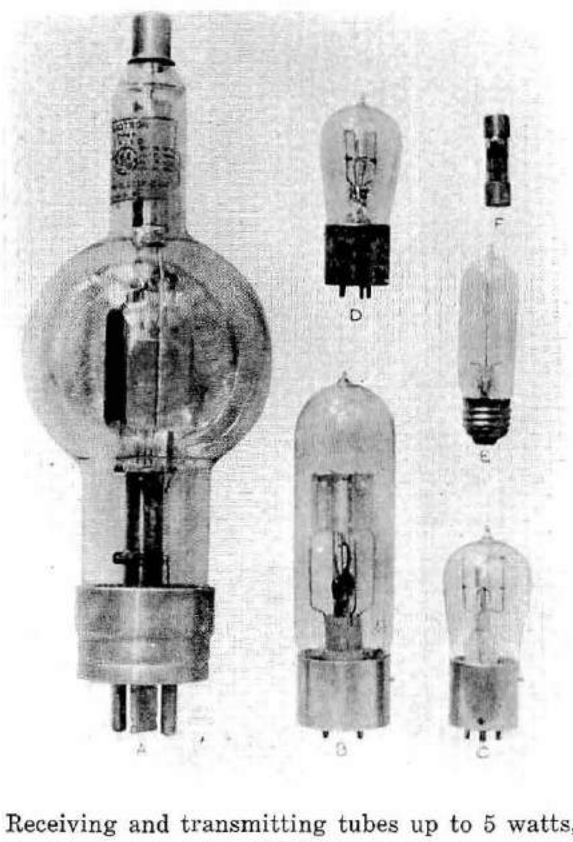
## INCIDENCE OF BROADCASTING

Since the very beginning of man's ability to transmit sound electrically, interest existed in the possibility of widespread dissemination of news and amusement by telephony. Wire broadcast systems existed in several of the capitals of Europe around the turn of the century, but their growth was inhibited by the limited coverage and a technique inadequate in volume and quality.

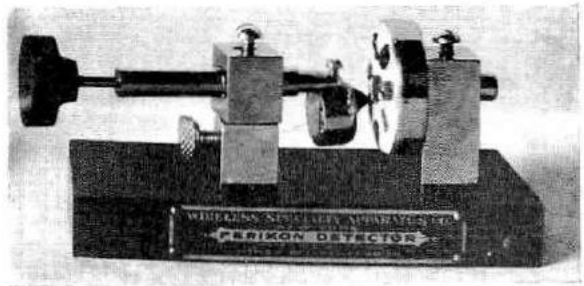
**1919-20**—Amateur listening and participation in radiotelephone test emissions in various cities of the country grew apace and formed the backdrop of radio broadcasting.

(de Forest and others had undertaken sporadic radiotelephone broadcasts since 1907, using initially arc transmitters.)

Stations which first emitted regular enter-



Receiving and transmitting tubes up to 5 watts, 1918.




Perikon detector, favorite of the 1910 period. Product of Professor Pickard.

tainment programs, the services of which continued:

*The Detroit News,* starting by October 1920, using a de Forest vacuum tube transmitter.

Station of the Westinghouse Company in East Pittsburgh, KDKA, starting in November 1920, first licensed broadcasting station.

**1921**—Station established by the Westinghouse Company in Newark, N. J., WJZ.

So great became the demand for broadcasting stations that the government authority, then the Department of Commerce under Hoover, held the first National Radio Conference to regulate the frequency assignment and time dividing. Stations at first were crowded on a common wavelength of 360 meters.

**1922**—The beginning of toll broadcasting, which was to solve the economic problem of how to sustain the service, in the telephone company's New York station WEAF.

Beginning of the making of field strength measurements.

**1923**—The initiation of network broadcasting over telephone circuits between WEAF and the Shephard Stores' station in Boston, WNAC; and then with Colonel Green's station at Round Hill, Mass., WMAF. Followed by the linking of stations in New York, Schenectady, Pittsburgh and Chicago for a meeting of the National Electric Light Association.

**1924**—Broadcast transmitting stations get up to 5 KW power using water-cooled tubes; first use of crystal controlled transmitter, WEAF.

## Pillars of Wireless

*(Listed according to date of birth)*

MAHLON LOOMIS—He should be included in the list of wireless experimenters because he used the upper strata of air to connect his kite-erected antennas at sender and receiver. He even used static electricity as an aid, not as a deterrent, making use of it to "power" his wire-air strata-wire circuit. He actually covered a distance of fourteen miles by this method, which depended essentially of robbing the aerial stratum of its charge at one point, thereby causing a lessened discharge to earth at a distant point, at his receiver. Void of practicality, Loomis' demonstration nevertheless pointed a scientific moral.



MAHLON LOOMIS



JAMES CLERK MAXWELL

JAMES CLERK MAXWELL—Not the experimenter, but the introversive scientist, he was first to bring into prominence the "missing link", the ether, which in our day, with the universal urge of scientists to replace one theory with another, is called "that supreme paradox of Victorian science and yet a triumph of the scientific imagination." This will probably be replaced as a "convenient fiction" at approximately twenty-five year periods as time goes on.

PROF. AMOS E. DOLBEAR



AMOS EMERSON DOLBEAR—Inventor of an electrostatic telephone, capable of working as transmitter and receiver, he sought to transfer this from line wire to kite-elevated antenna. His electrostatic lines of force refused to detach themselves from their home wire and migrate into space, as did the later waves of Marconi, hence his attained distance of transmission was negligible.

THOMAS ALVA EDISON—The world's greatest example of practical experimentation, Edison ventured several times upon the threshold of wireless communication, but each time lacked the key to open the door into the ether. His discovery of the flow of current, in one direction, through the "empty space" of his electric lighting bulbs led, through the Fleming valve and the de Forest audion, to our present greatest magic tool. His observation of mysterious sparks created in myriad places by the discharge glinting at the vibrator of a magnetic interrupter led him to call this effect, rightly, "etheric force", but he never traced it to its true source. His induction telegraph experiments, the pioneer effort to enable moving

trains to communicate with stations and signal towers, lacked the flexibility later furnished by the waves of Hertz and re-



JOHN AMBROSE FLEMING

mained a scientific toy.

JOHN AMBROSE FLEMING—Ponderous creator of early dicta on the theory and practice of wireless communication, he gave to the world a very early computer of the extent of ether waves, the "cymomter", the Fleming valve, first dipole, and the first electronic detector used in wireless reception.

OLIVER HEAVISIDE—Mathematician of the uppermost heights; inward-living, steeped in thought, he gave the world its first dim conceptions of the basis of propagation of electrical waves, and pointed out initially the infinitely tenuous layer which acts as the "mirror" to reflect wireless waves, heading for the infinite, back to earth.

OLIVER LODGE—Probing into the unknown, where wireless dwelt, he studied it in theory, and applied that theory to material better-



OLIVER LODGE

ment, particularly in the realm of resonance. Led from the physical into the psychical, it remains for the indefinite future to demonstrate his ability to establish contact with earthly things.

HEINRICH RUDOLPH HERTZ—First to create, detect and measure electromagnetic waves, originally prophesied by Maxwell, he confirmed the latter's theory. Using primitive available devices, he conducted amazing experiments not only as to the creation and detection of ether waves, but concerning their reflection, refraction and velocity, all with the exactness of the physicist.

MICHAEL IDVORSKY PUPIN—Great electrophysicist, inventor, and educator, he touched directly upon wireless in only a limited way, chiefly in early work on a special form of electrolytic detector, in development of the loading coil, and in tuning in general. As a teacher, however, in the schoolroom and in the pages of the technical press, his influence was great indeed. Perhaps his greatest credit in Fame's ledger is that he piloted the early, thorny way of a young enthusiast who afterward became one of radio's leaders, Edwin Howard Armstrong.

NIKOLA TESLA—Brilliant, erratic, daring experimenter, he would make wireless a



NIKOLA TESLA

global agitator, not a mere activity existing between two distant points. Indeed, communication seemed a paltry use for such gigantic influences as oscillatory currents. He sought to have them carry unlimited power to distances limited only by the contour of the earth's sphere. Failing, he never ceased to dream, and whether in the solitude of his study or amid the admiring plaudits of his constant friends, he never lost faith in his own, his novel, originations.

ARTHUR EDWIN KENNELLY—Choosing the career of a mathematical physicist, he probed the mysteries of the ether, and, independent

of the similar work of Oliver Heaviside, proved the existence of an electrically conductive layer high above the earth. In combined honor to these separate discoverers, it is proper that this reflecting cloud should be known today as the Kennelly-Heaviside layer.

GEORGE OWEN SQUIER—Military scientist, poet of engineering, this leader-for-a-time of the United States Army Signal Corps found opportunity between routines of military signalling to devise a form of "wired wireless", to use trees as antenna pick-ups, and to experiment with other forms of wireless more esoteric than military formations.

REGINALD AUBREY FESSENDEN — This stormy petrel of wireless was perhaps the most strenuous and prolific of radio's inventors. To him belongs the credit for the beginning of the radio alternator, the heterodyne system of reception, the electrolytic detector, and early wireless telephony. With a dynamic, inspiring imagination, a booming and dictatorial manner in matters creative, and an utter disregard of the value of money, he made an impression on the development of wireless that is eternal. His station at Brant Rock, Mass., "BO", will live forever in memory, as will his compressed air condensers, ideal in theoretical value, and his synchonous rotary gap, which marked the upper point of spark transmission, prior to the general acceptance of the quenched gap.

LOUIS WINSLOW AUSTIN — This measurer of the ether lived an ideal existence as the scientific radio expert of the United States Navy. Hidden in the quiet confines of the Bureau of Standards, he flung radio tentacles into space, and sought the causes of fading and of static interference. With Dr. Louis Cohen he developed the Austin-Cohen formula for determining the radio effect due to a given radio cause.

JOHN STONE STONE—He selected selectivity as his gift to a decrement-tortured ether. Realizing the stimulation of mutual argument, he founded the world's first wireless engineering society, from which stems in first degree the Institute of Radio Engineers.

LEE DE FOREST—Creativeness tortured him in its many phases. As a result he gave to the world three three-electrode electronic devices: the detector, amplifier, and oscillator on which the modern radio art is based. His grid, applied as a traffic policeman of electrons, proved to be the Archimedes-de Forest lever that, in certain fact, moved the world.

GUGLIELMO MARCONI—He and many others pondered on the experiments of Hertz, and while others dimly saw the possibility of transmitting thought without wires, he was the first to translate this into a key and a detector connected by ether waves. Popoff, at that same time, sought to receive and record static; Marconi's effort for long years, was to reject it. Fortunate in finding business backing, he gained rightfully the title of Father of Wireless Communication.



GREENLEAF W. PICKARD

GREENLEAF WHITTIER PICKARD—Of him it could never be said that his life was crystal-clear, what with silicons, perikons, and pyrons emitting from him in regular sequence. With the poetical nature of his illustrious ancestor, his detectors were poems in mineral form. Led astray in later years into the dim by-paths of litigation, he later returned to his first love, with the difference that his modern crystals control rather than detect.

FRANK CONRAD—Unassuming, an amateur at heart, Conrad was the first to create and establish a public broadcasting station. That station was and is KDKA. It stemmed directly from radiophone tests in his home

town of East Liberty, Pa., during World War I. In later years, by a dramatic experiment in London during a conference, he demonstrated the especial value of short waves established once and for all time their effectiveness for long distance work.

ERNST F. W. ALEXANDERSON—Creator of the Alexanderson radio-frequency alternator, perhaps the most elegant machine ever known in the realm of radio, he devised as well the multiple-tuned antenna with its outdoor coils mounted on concrete. He is also famed for the development of the tuned radio-frequency amplifier. A pioneer in television, he and G.E. gave early demonstrations in Schenectady, using a mechanical scanner, which later fell before the more versatile electronic method.

A. HOYT TAYLOR—A teacher and professor outwardly, within he was a seeker of the new. His early probing into short-wave technique led him into the realms of Navy Radio during World War I. Since then he has been the engineer-cum-scientist of the U. S. Navy to their mutual advantage. A pioneer in radar, his work stems back to the first observation of the interference produced by a metallic structure passing between transmitter and distant receiver. By self-confession he is in equal parts, physicist, inventor, naval officer, and engineer.

ALBERT WALLACE HULL—He is inventor of the magnetron, a form of ultra-high-frequency electronic generator, which has won new fame in the field of radar. Predecessors, also to his credit, were the dynatron and pliodynatron. First to place the finger of proof on the "shot-effect" as a cause of receiver noise, his work led to the development of the screen-grid tube, sans feedback. The thyratron also looks to him as its creator.

IRVING LANGMUIR — Essentially a chemist and metallurgist by early training, he applied these factors to radio tube design with marked success. His discoveries are abstruse as to nature and title, such as the accepted concept of adsorbtion and orientation of molecules at surfaces; also the mechanism of gas reactions at the surface of metallic tungsten. One of the only scientists known who admits that he worked "for the fun of it."

ROY ALEXANDER WEAGANT—He gave his entire mature life as an engineer to the solving of Nature's uncontrolled vagaries in the field of radio communication. He early developed the theory that static, eternal bugaboo of wireless, originated in a source directly overhead, and thus could be solved by directional antennas, the latter being arranged in circuit so that they would balance out signals from above (static) and receive with enhanced valuation signals in line with their horizontal extension (signals from the wanted station). Years of experiment proved his theory; his was the first really operative static-reducing system.

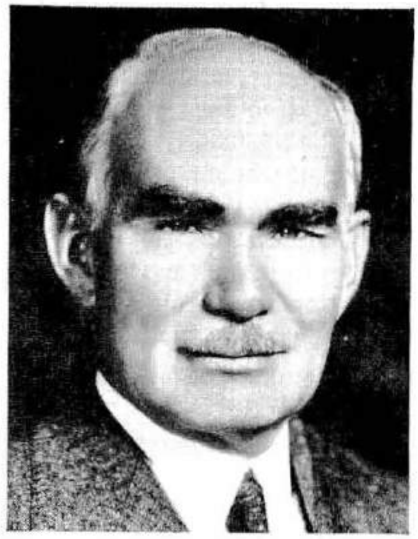
FREDERICK AUGUSTUS KOLSTER — Spurred into early action by his superior, John Stone Stone, Kolster in later years developed the first practical direction finder for shore or ship, a rotatable loop with associated amplifier. This was taken over by the U. S. Navy

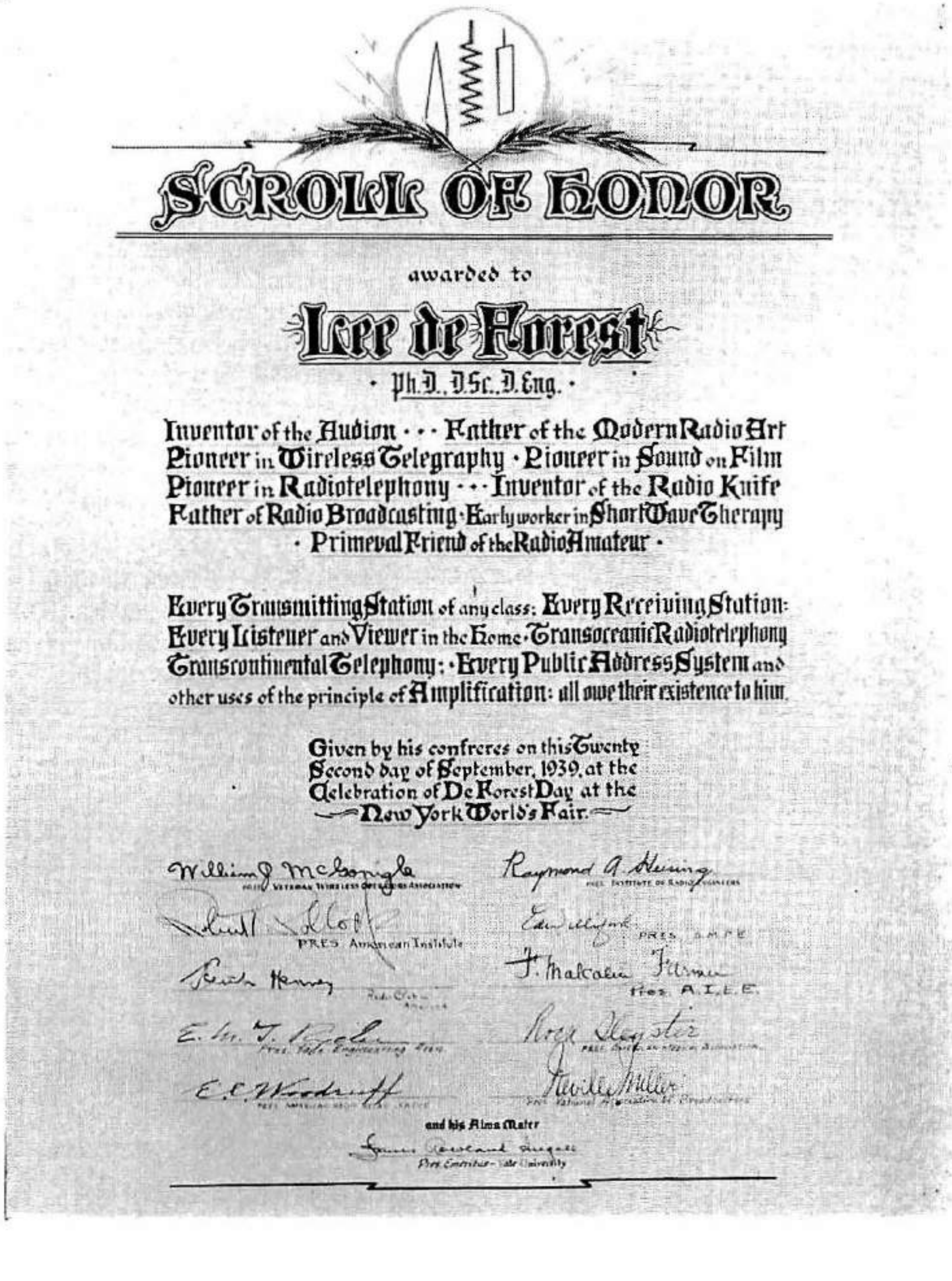


LOUIS A. HAZELTINE

during World War I. He also developed, during the same period, a combined wavemeter and measurer of damping which gave a quick and correct indication of the latter by a sim-

Dr. Lee de Forest and the Scroll of Honor awarded him on de Forest Day at the New York World's Fair, as a combined tribute from Yale, his Alma Mater, and the leading engineering and radio associations.




SCROLL OF HONOR

awarded to

Lee de Forest

· Ph.D., D.Sc., D.Eng. ·

Inventor of the Audion ··· Father of the Modern Radio Art
Pioneer in Wireless Telegraphy · Pioneer in Sound on Film
Pioneer in Radiotelephony ··· Inventor of the Radio Knife
Father of Radio Broadcasting · Early worker in Short Wave Therapy
· Primeval Friend of the Radio Amateur ·

Every Transmitting Station of any class; Every Receiving Station:
Every Listener and Viewer in the Home · Transoceanic Radiotelephony
Transcontinental Telephony: · Every Public Address System and
other uses of the principle of Amplification: all owe their existence to him.

Given by his confreres on this Twenty
Second day of September, 1939, at the
Celebration of De Forest Day at the
New York World's Fair.

Pres. A.I.E.E.

Pres. American Institute

and his Alma Mater

Pres. Emeritus – Yale University

ple movement. This instrument, called the Kolster Decremeter, was of great value during the latter days of the spark era.

HAROLD DEFOREST ARNOLD—Noting the gas content of the first audions obtained from deForest by the American Telegraph and Telephone Co. and the consequent limitation of operation thus engendered, he set about remedying this fault by producing gas-free tubes. Thus the three-element vacuum tube became a reliable device for amplification and other uses.

LOUIS ALAN HAZELTINE—No sooner had regeneration been developed than Hazeltine set out to neutralize, or at least, to control it, using therein his famous neutrodyne circuit. A teacher by heart, a physicist to whom mathematics was amusement, he lifted the vacuum tube amplifier out of the sphere of chance and made it a calculable device. It has been said that he took the squeaks and howls out of radio by means of calculus, but this he denies, stating that physical means were at the back of it all. Successful as an inventor, he never lost his major desire, to teach others, and today he pursues this aim with undiminished vigor.

ALFRED NORTON GOLDSMITH—Versatile as no other major tenant in the house of radio, Dr. Goldsmith is equally at home in the fields of radio, motion pictures, and instruction. He is radio's outstanding "practical visionary", and in addition to being passionately addicted to his work, he is paid for it, as well. He is a brilliant author, who never goes over the heads of his readers, but instead enters their minds with a simple explanation of difficult subjects so that they understand what he is talking about. He clasped the infant Institute of Radio Engineers to his breast at its birth, and by untiring efforts and pecuniary assistance persuaded it to live and become the sturdy organization that it is today. For many years he was I. R. E.'s Secretary, and Editor of its Proceedings. His influence on the growth of the Institute has been greater than that of any other member, and yet has been done with so little ostentatiousness that only those of the inner circle truly appreciate the greatness of his gifts.

JOHN HAYS HAMMOND, JR.—His youthful enthusiasm for telautomatics led him to a lifetime of experiment biographed by innumerable patents. The musical whispers of those early days increased to an organ roar. Housed in a mediaeval castle, his thoughts are ever in the far future.

WILLIAM DUBILIER—The major bugaboo of the spark transmitter, first worker of wireless stations, was the condenser. At first of glass, it either punctured easily, or, if designed against this, took up inordinate space. Later designers sought to substitute mica, which had to be used in sectional form. There trouble centered. Impregnation, sectional distribution, and other factors were sources of breakdown even though necessary. Spurred on by the insistance of the Government, as were other manufacturers, William Dubilier was the first to evolve a mica unit which conquered all these defects and withstood all the strenuous demands of Government specifications.

RAYMOND A. HEISING — Designer of the famous Western Electric radiotelephone sets used in sub-chasers during World War I, and of some of the earlier airplane sets of the pioneer period, Heising took part later in the development of ship-to-shore and transatlantic commercial radiotelephony. He served especially in devising multi-channel systems. Constant current modulation, used universally in the earlier high-power broadcasting stations, sprang from his facile hand.

RICHARD HOWLAND RANGER — Owen D. Young was the father, and Dick Ranger (in an engineering sense) the mother, of RCA's first radiophoto system. The former gave a lecture to the engineers one day in the early 1920's, stating that he wanted to see a page of the London Times radioed to New York with a "single zip-p-p." Ranger started out to do it. By painstaking attention to synchronization of transmitter with over-ocean receiver; with an ingenious means of insuring that each element of a scanned picture imprinted an element of like strength on the receiver paper, Ranger produced model after model, each bettering its predecessor. Finally, on November 30, 1924, recognizable facsimiles crossed to New York from London. Other successes followed. Before long, facsimile service by radio became standard commercial procedure. Checks were cashed

by its ether-wave signature; criminals were caught by its identification.

VLADIMIR KOSMA ZWORYKIN—The man who changed the face of television, by providing an electromagnetic, weightless finger for scanning instead of the existing mechanical, unworkable methods, is the father of two children well known to the radio art and to a lesser extent to Citizen Radio—the Iconoscope and the Kinescope. The former scans the scene to be televised and turns it, element by element, into radio-wave impulses, which, impressed upon the receiver, are turned back into interlocked elements which form a moving picture before the eye of the viewer. Another of his accomplishments is the electron microscope which enables man to peer deeply into the sub-microscopic world. In spite of having opened to man a new world, Zworykin is modest, possesses a great sense of humor, and is as approachable as his office boy.

JOHN VINCENT LAWLESS HOGAN — When de Forest made his first grid audion, Jack Hogan made the first curve showing the variation of the plate current with grid voltage. That shows how far back he goes, although his appearance belies it. Working for Fessenden thereafter, he devised, with J. W. Lee, the form of heterodyne in use today, and, in 1912, superintended from Arlington, NAA, the official test of the same on the cruiser *Salem*, where his co-inventor directed the installation. He was an early inventor of single-dial control. Being faithful by heart, ear, and engineering training, he founded the first high-fidelity station, W2XR, which later became WQXR. Bach, Brahms, Beethoven and Hogan have given pleasure to the critical musical ear of many New Yorkers.

EDWIN HOWARD ARMSTRONG—Radio history does not contain another instance of an amateur who succeeded to the same degree by sheer ability as well as forcefulness, in reaching the top round of the ladder of success. His story is a wonderful blend of personal ability, assisted and guided by others far above him, and final recognition by his fellow engineers.

As a lad in short pants, Edwin devised a strange arrangement of interacting coils which gave, with a little device in a black box, much louder signals than any other known at the time. The secret in the box was the audion; the circuit formed by the coils was the famed feedback circuit. That subsequent court decisions took away his legal priority does not detract from the very able work done by this mere lad, no more than it does from the equally able work done by his opponent in this legal battle, Dr. de Forest and his assistants.

Professor Pupin took young Armstrong under his protective wing, and it was his tutelage that to some major degree gave Edwin the initial impetus toward his present high position. That the lad received this aid gratefully and always acknowledged it is a beautiful sequel, for so many rise to fame by the aid of others, and forget their earlier assistance.



HAROLD H. BEVERAGE

Perhaps Armstrong's greatest contribution to fame was the superheterodyne receiver, which became immensely popular during the early craze of the American public, and which is used today to a very great extent. The super-regenerative receiver was another similar devisement.

Still another of his radio magic series is Frequency Modulation, which, as usual, is not free from litigation's eagle eye, but which again he did, as a matter of actual operation, at a very early date. This system, FM, defies the lightning and its infant static, and is rapidly being taken into the radio art as a standard.

Both in World War I and II E. H. Armstrong rendered signal service to the U. S. Signal Corps, and has received certificates of appreciation therefor which would make anyone but Howard Armstrong, the most modest inventor in the history of the radio art, unbearable to live with.

HAROLD HENRY BEVERAGE—Harold Beverage was once known as "the man with the long wire." Having worked on static reduction at Otter Cliffs and elsewhere during World War I, he proceeded at its close to lay a wire nine miles long on Long Island, choosing the site because of its name. As the length increased, the directivity became more pronounced, and after other devices were added, the "wave antenna" became the standard method of reception for long-distance, long-wave signals.

Later, while he and his assistant were comparing signals over a line connecting both of their homes, where each had a receiving station, they found that never did signals fade out at the same time on each receiver. From this the diversity reception system was formed, where three receiving antennas, far apart, work on a common detector. Thus there is always one antenna providing good reception.

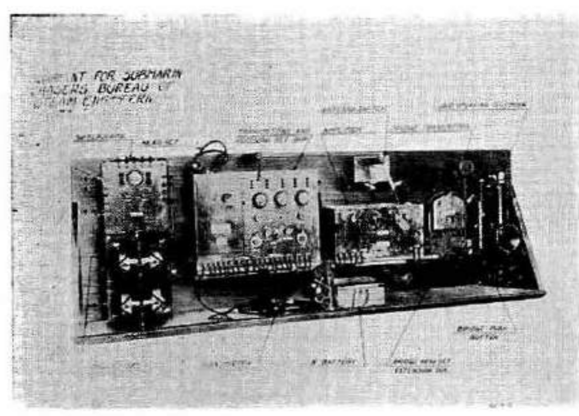
STUART BALLANTINE—Brilliant to the extreme, erratic to the extent that he never accepted the usual explanation, Stuart Ballantine led a most active radio existence during his too-brief life. A mathematician of rare ability, a physicist, a radio engineer of both practice and theory, he was able to start from that advanced point and go on into the unknown. His first work in wireless was in the field of direction finders, while serving the United States Government as radio expert. His analyses of coil antennas, by mathematics, greatly improved the design of these necessary factors. He devised a "compensator" to remove the "antenna effect" from the compass loop, thus sharpening observations. In collaboration with H. A. Snow, he devised the "variable MU" principle for vacuum tubes, giving the grid a variable pitch.

ALLEN BALCOM DUMONT — Specialist in radio and X-ray tubes and oscilloscopes, Dumont soon found his way into television, his present chief interest. He was an employee of de Forest for some years, as chief engineer, with special reference to vacuum tubes. He was the deviser of the "magic eye", or visual tuning-indicator.

PHILO TAYLOR FARNSWORTH — Disdaining earlier art, Philo Farnsworth started a small laboratory in 1926, in California, where he devised a dissector tube and a multipactor tube, the latter an amplifier for the former.

(With credit to Orrin E. Dunlap, Jr., who in writing "100 Radio Men of Science", did it first and at greater length.)

—Contributed by George H. Clark.



CW936 radiotelephone transmitter installed extensively in subchasers in World War I by U. S. Navy.




First radio sets used in an airplane by U. S. Army before World War I.



Marconi station at Boulogne, 1901, from which signals were exchanged across the English Channel in August, 1899.

# A YEAR-BY-YEAR BOOK OF WIRELESS

**1872**

Mahlon Loomis, a Washington, D. C., dentist, is granted a United States patent (No. 129971) for an improvement in telegraphy —the system proposed is for use without conducting wires, but requires a conducting layer of air above the earth.

**1879**

Hughes discovers the phenomena on which depend the action of the coherer used later in systems of radio telegraphy.

**1883**

Fitzgerald suggests a method of producing electromagnetic waves in space by the discharge from a conducting wire.

From Maxwell's equations, Poynting concludes that in all cases where energy is transferred in an electric system it flows parallel to the surfaces of both electric and magnetic equipotentials.

Thomas A. Edison discovered the "Edison Effect" and made the first real electron tube.

**1884**

The American Institute of Electrical Engineers organized, May 13, by a number of prominent telegraph officials and engineers. Norvin Green elected president.

S. J. M. Baer presents a paper before the American Institute of Electrical Engineers, New York, on the subject "Telegraphing Without Wires."

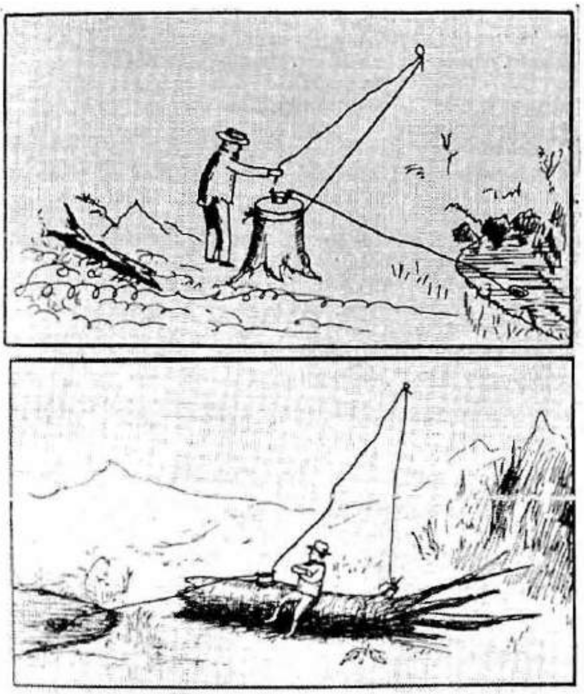


Diagram of Mahlon Loomis experiment in which the "grounding" of one section of an electrified cloud caused changes in a galvanometer inserted in a distant wire.

1885

Edison, assisted by Gilliland, Phelps and Smith develops a system of telegraphing by induction between moving trains and stationary offices.

Richards, of the Bell Telephone Company, Boston, introduces the headband telephone receiver.

1886

M. Mercadier, in France, invents a system of wire signaling which he calls a RADIOPHONE. It is a tone system of telegraph signals transmitted through a telephone transmitter and received in a telephone receiver.

1887

Hertz, in Germany, shows that electromagnetic waves are practically identical with waves of light and heat.

1888

A. E. Kennelly, senior electrician of the ship's staff, Eastern Telegraph Company, England, comes to America and is appointed electrician in the Edison laboratories at Orange, N. J.

E. H. Lyons, engineer with the Bell Telephone Company, develops a telephone amplifying repeater.

Photoelectric effect is discovered.

1891

Eduard Branley, in France, announces the discovery that the effect of electrical oscillations upon a body of metallic filings is to produce an increase in the electrical conductivity of the filings.

1892

Professor George Forbes, of Edinburgh, suggests that the Branley filings tube will respond to the action at a distance of Hertz' waves.

The Society for the Promotion of Engineering Education founded.

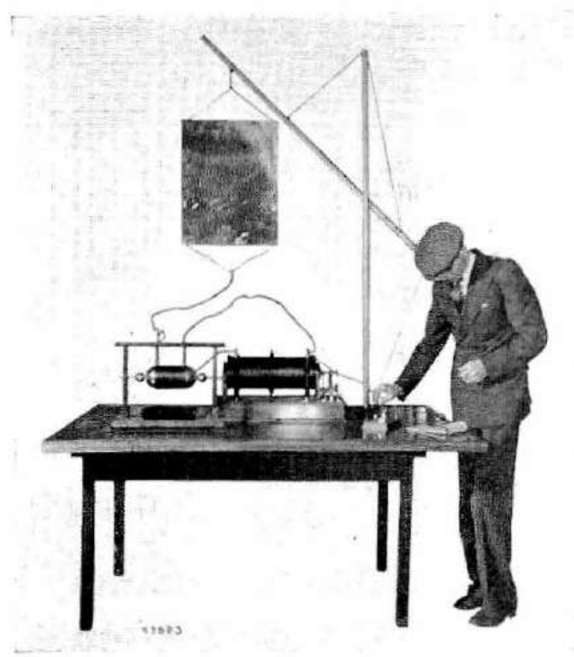
1894

Oliver Lodge, in London, at a lecture exhibits various forms of coherer tubes in operation.

Heinrich Hertz dies. (Born in Germany 1857).

1895

Professor Alexander Popoff, St. Petersburg, Russia, presents a paper (April) before the Russian Physical Society, on the subject "Apparatus for Detecting and Registering Electric Waves."



Replica of first wireless set used by Marconi on his father's estate in Italy, 1895.

Guglielmo Marconi, in Italy, experiments with Hertz' oscillator and Branley's filings tube.

1896

The electron is identified and determinations made relative to its physical characteristics.

1897

Marconi gives a demonstration of his wireless system on Salisbury Plains, near London, (March) and files a complete patent specification.

Oliver Lodge, in England, on May 10, files a provisional patent application covering inventions in wireless signaling.

In May, trials of Marconi's system are made over water, between Lavernock and Flatholm, a distance of three miles. On the 13th, communication is established between Lavernock Point and Brean Down, a distance of eight miles. Professor Slaby, a German scientist, was present at these demonstrations.

Professor Slaby gives a lecture (August 27) at Potsdam, before the German Emperor and Empress, on the subject of wireless telegraphy.

The first Marconi station is erected at the Needles, Isle of Wight. A distance of fourteen and one-half miles is bridged by wireless telegraphy.

In December the Marconi station at the Needles communicates with a ship eighteen miles at sea.

**1898**

Simon, in Germany, develops the speaking arc.

A. E. Kennelly is elected president of the A. I. E. E., continuing in this office throughout the years 1899 and 1900.

Oliver Lodge, in England, files a complete specification covering inventions in wireless telegraphy.

Jagadis Chunder Bose, of Calcutta, India, at a British Association meeting at Liverpool, exhibits and gives an account of "A Complete Apparatus for Studying the Properties of Electric Waves."

The steamer *Flying Huntress,* equipped with Marconi apparatus, follows the yachts at the Kingstown Regatta, Dublin, July 20-22, and reports results of the race.

Wireless telegraph apparatus is installed on the East Goodwin Lightship and at the South Foreland Lighthouse, England, December.

**1899**

M. I. Pupin reads an important paper before the A. I. E. E., New York, March 22, dealing with the mathematical theory of wave propagation over metallic conductors.

Wireless telegraph communication is established across the Strait of Dover between Wimereux, France, and the South Foreland Lighthouse, England.

In July, British warships are equipped with Marconi apparatus. A distance of eighty-five miles is bridged by wireless.

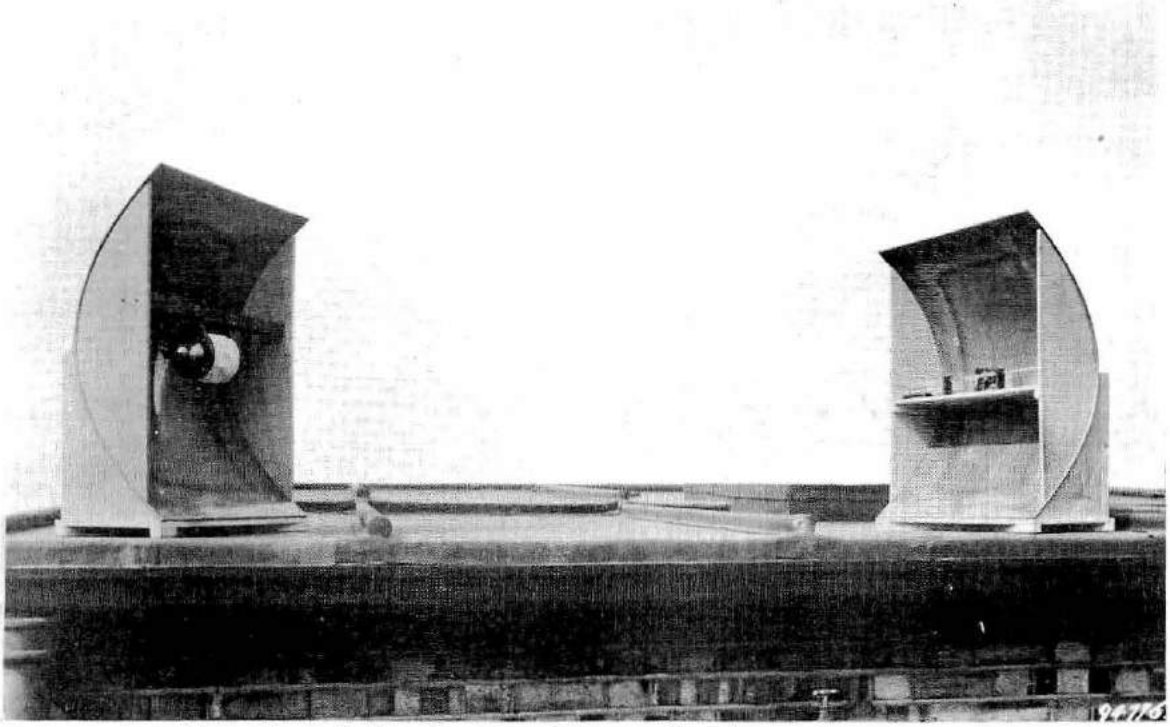
Electrical Standardization Rules, prepared by an Institute Committee, are adopted by the A. I. E. E.

Reginald A. Fessenden, of Washington, D. C., develops improvements in methods of wireless telegraph signaling.

Hayes, in New York, transmits music over a beam of light.

During the International Yacht races between the *Columbia* and the *Shamrock* off New York harbor, September, the New York *Herald* uses Marconi's wireless telegraphy to report the progress of the race.

United States war vessels make trials of Marconi's wireless telegraph system. The cruiser *New York* and the battleship *Massachusetts* are equipped with apparatus.



Marconi parabolic antenna used in experiments forty years ago.

The British war office sends six Marconi electricians to South Africa with wireless telegraph apparatus for use by the army and navy in the British-Boer war.

1900

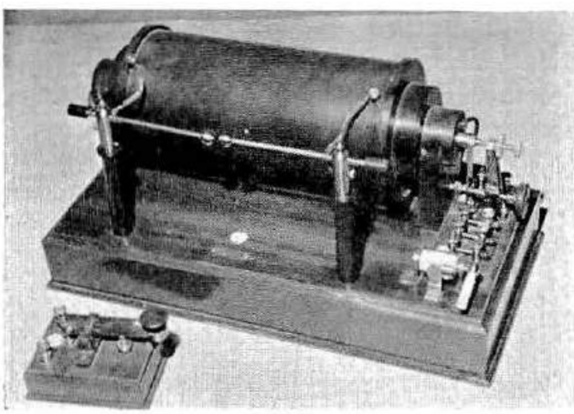
Wireless telegraph apparatus is installed on the German ship *Kaiser Wilhelm Der Grosse.* (March)

The Marconi International Marine Communication Company organized, April 25, in London.

Dudell, in England, discovers that a direct-current arc shunted with a condenser in series with a self-inductance coil will, under certain conditions, give out a musical note, and transform part of the direct- into alternating-current with constant amplitude.

1901

Marconi wireless telegraph service is in-



The "famous" Marconi ten-inch spark coil.

augurated between islands of the Hawaiian group, March 1.

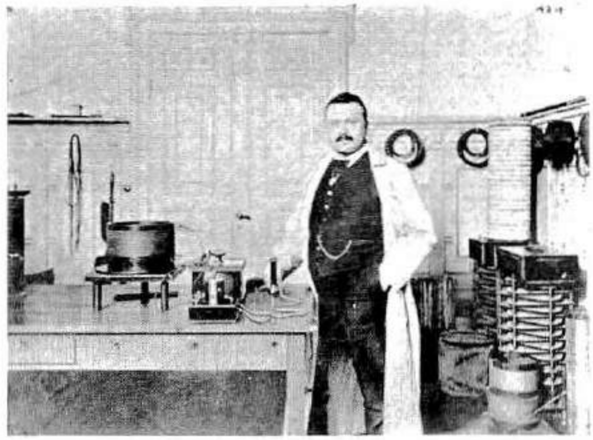
The Canadian Government orders two Marconi telegraph sets for use at coast points along the Strait of Belle Isle.

Marconi, at St. Johns, Newfoundland, receives a wireless telegraph signal in the form of repetitions of the letter "s" from the Marconi station at Poldhu, Cornwall, England, December 12.

A generator of 1 kw. capacity, at 10,000 cycles, is built in the United States for wireless signaling purposes.

Marconi invents the magnetic detector, for the detection of wireless signals.

Lee de Forest, in Chicago, develops a system of wireless telegraphy.



VALDEMAR POULSEN
Inventor of the Poulsen arc.

The wireless telegraph system invented by M. Rochefort, in France, is given a trial by the United States navy department.

R. A. Fessenden procures U. S. patent No. 706737 for a system of radio signaling employing long waves (low frequency).

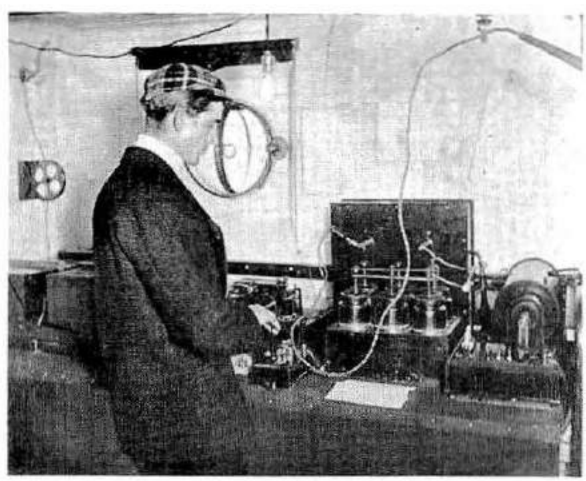
Mr. Marconi, in February, on board the *S. S. Philadelphia,* receives wireless signals over a distance of 1,551 miles.

Emperor Wilhelm, of Germany, issues an order giving the Slaby-Arco system of wireless telegraphy exclusive rights in Germany.

A. E. Kennelly is appointed professor of electrical engineering at Harvard University.

The Pacific Wireless Telegraph Company establishes communication between San Pedro, California and Santa Catalina Island.

The Marconi Wireless Telegraph Company



First experimental ship radio installation in U. S., on the *S.S. St. Paul,* 1899.

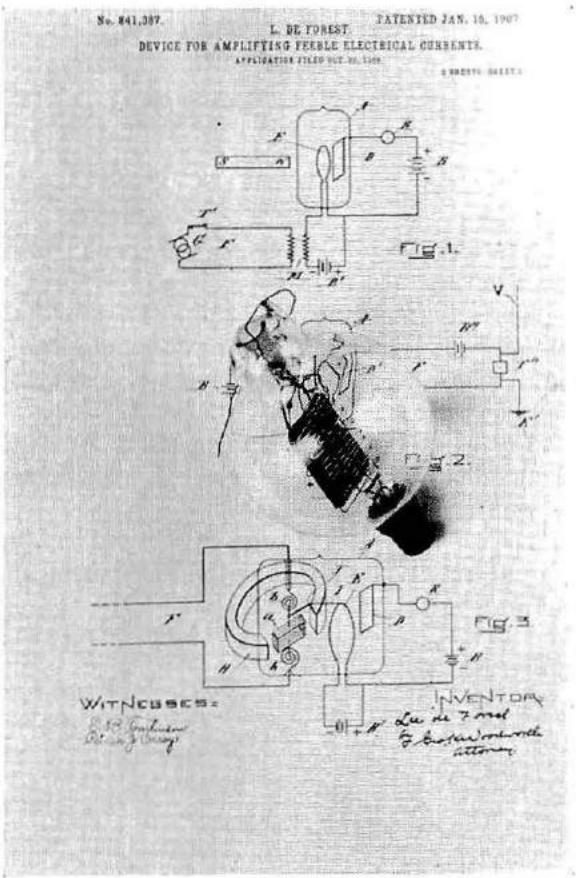
builds a high power station at Glace Bay, Nova Scotia.

The Marconi Wireless Telegraph Company of Canada established a station on Cape Breton for long distance working.

John Stone Stone of Boston, is granted patent No. 714831, later adjudged by the U. S. Supreme Court as the basic patent on coupling.

1903

On March 30, what is said to be the first trans-atlantic radio complete message is received by and printed in the London *Times.*

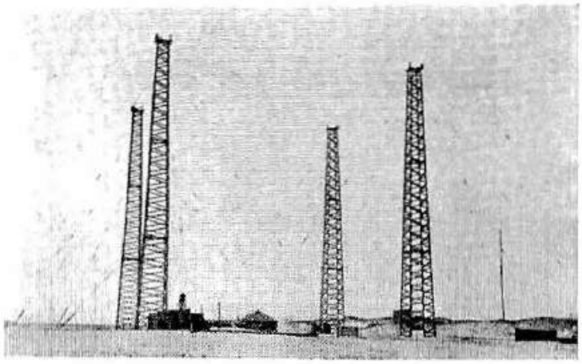



DeForest amplifier patent.

Poulsen, of Denmark, obtains (June 19) a United States patent (No. 789449) covering the invention of a hydrogen-arc transmitter for radio signaling.

The first International Conference to consider questions relating to wireless signaling is held in Berlin, Germany, August 4.

John Stone, of Boston, is granted a number of patents covering improvements in wireless telegraph systems.



High-power station of Marconi's Wireless Telegraph Co., Ltd., at Wellfleet on Cape Cod. Its call letters were first "CC" and then "WCC".

Harry Shoemaker, in the United States, is granted a number of patents covering wireless telegraph inventions.

Wireless telegraph communication is established by officers of the United States Signal Corps, between Safety Harbor and St. Michaels, Alaska, a distance of 107 miles, November 5.

C. P. Steinmetz made a 10,000 cycle, 1-kilowatt alternator for R. A. Fessenden's early experiments.



The Wireless

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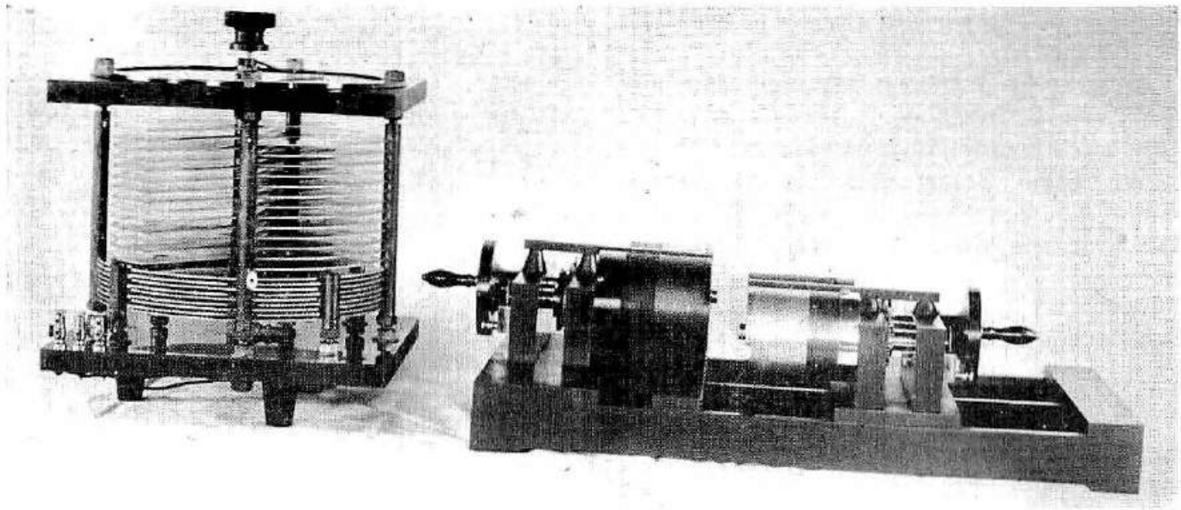
AVALON, MARCH 25, 1903.

A FAR CRY FROM THE SEA.

NEWS OF THE MORNING.

Second Edition.

Early use (1903) of wireless to carry news by air to an island.



Early receiver equipment of the National Electric Signaling Co. Left: receiving condenser, variable plus fixed; right: the famous "Fessenden V.I.", or variable inductance.

1904

The Western Union Telegraph Company announces (March 1) the acceptance of messages for passengers on ships at sea, to be transmitted by wireless telegraphy. Thirty-two Atlantic ships are equipped with wireless apparatus.

The first wireless telegraph act is passed by the British parliament.

1905

Mr. Marconi procures patent No. 14788, in England, covering the invention of the horizontal directional antenna.

J. A. Fleming, in England, develops the valve detector for wireless signaling.

The Marconi Wireless Telegraph Company begins the construction of a high power station at Clifden, Ireland (October).

1906

Lee de Forest, in the United States, is granted a patent (January 18) for a vacuum tube detector for wireless signaling, known as the Audion.

A second Radiotelegraphic Conference is held in Berlin, Germany.

For radio purposes R. A. Fessenden, at Brant Rock, Mass., employs a generator of one-half kw capacity, operating at 75,000 cycles.

Fessenden succeeds in telephoning a distance of eleven miles by means of wireless telephone apparatus.

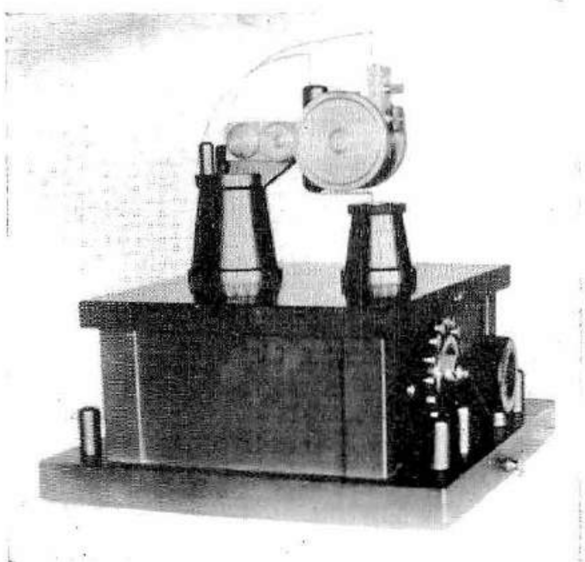
1907

The Society of Wireless Telegraph Engineers organized at Boston, Mass.

The Engineering Building, the new national headquarters of the national engineering societies, 33 West 39th Street, New York, is dedicated April 16.

For radio signaling purposes a 100,000-cycle electric generator of one k.w. capacity is constructed, in America.

Lee de Forest procures a United States patent for an audion amplifier of pulsating or alternating current.



First Fessenden Barretter or electrolytic detector, 1905.

**1908**

Marconi stations in Canada and England are opened for radio telegraph service across the Atlantic.

R. A. Fessenden has constructed a 70,000-cycle alternator with an output of 2.5 kw. at 225 volts, for radio signaling purposes. Fessenden reports successful radio telephone tests between Brant Rock, Mass., and Washington, D. C., a distance of 600 miles.

**1909**

The *S. S. Republic* and *S. S. Florida* collide off the American coast (January 23). The *Republic* sinks after all of her passengers and crew are rescued by other vessels called to her assistance by wireless telegraphy.

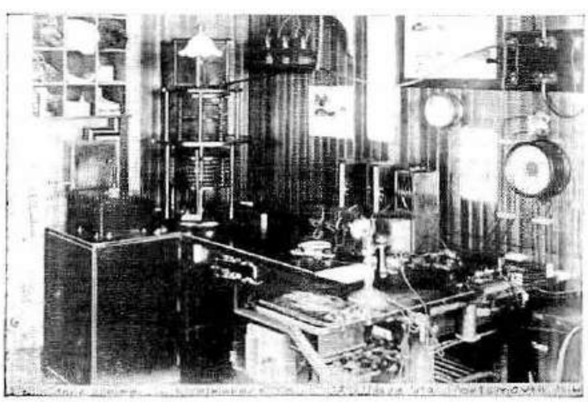
John Stone procures American patents Nos. 908814 and 908815 covering inventions in wireless telegraphy.

Marconi exhibits, in London, his multiple tuner for radio telegraph installations.

The Government, in January, called for bids for the construction of long-distance wireless telegraph stations. The following companies submitted bids: Telefunken Wireless Telegraph Company, of Philadelphia; National Electric Signaling Company, of Pittsburgh; Marconi Wireless Telegraph Company; Massie Wireless Telegraph Company, of Providence, R. I.; The Radio Telephone Company, of New York, and the Stone Telegraph and Telephone Company, of Boston.

E. Bellini and A. Tosi, in Italy, describe a new system of directive radio signaling.

The Burke Bill for the compulsory use of



Stone Telegraph and Telephone Co. installation at Navy Yard, Portsmouth, N. H., 1906. Loose-coupler; break key; protective device.




"Frank" book, issued by the "United" Company.

radio telegraphy on certain classes of vessels is passed by the House of Representatives.

G. W. Pickard, of Amesbury, Mass., procures U. S. patents numbers 912613 and 912726 covering the invention of crystal detectors for radio signaling.

The Wireless Association of America is organized by Hugo Gernsback, New York. (The society merged with a later organization in the year 1913.)

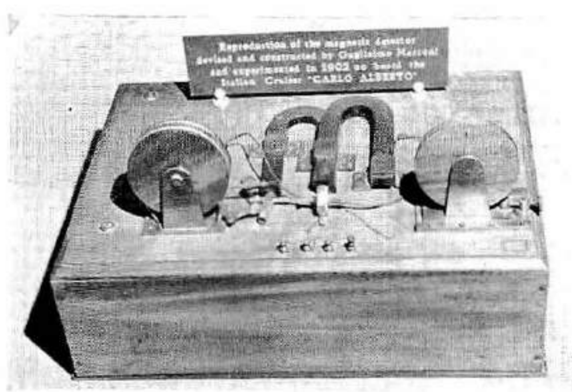
The Wireless Institute of New York is organized.

T. Giara, of Boston, Mass., invents a system of multiplex telegraphy applicable to radio signaling. (U. S. patent No. 914713.)

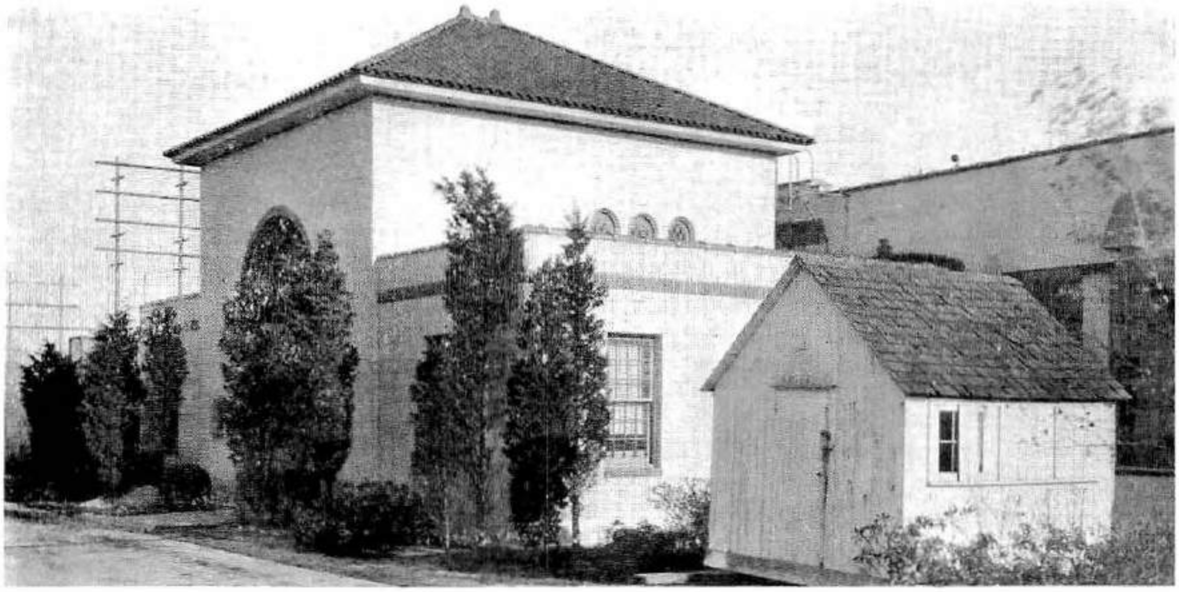
The United Wireless Telegraph Company establishes direct communication between their New York and Chicago offices (May 2).

The United Wireless Telegraph Company, also the Radio Telephone Company of New York (de Forest and Stone systems) begin the erection of a number of radio stations in the Central and Western states.

The Ohio State University plans a regular



Early model of Marconi magnetic detector.



Left: The first wireless telegraph station in America, at Babylon, L. I. Presented by Edwin H. Armstrong to RCA and installed at Radio Central.

course of instruction in radio telegraphy and radio telephony.

G. W. Pierce, of Cambridge, Mass., is granted a patent covering the invention of a tuning system for radio signaling.

The Wireless Institute, New York, appoints a committee to compile radio standardization rules and to frame definitions for radio engineering terms.

C. D. Babcock, of New York, procures a number of U. S. patents covering inventions in radio signaling apparatus.

Alfred N. Goldsmith reads an important paper before the Wireless Institute, New York, November 3, on the subject of Wireless Telephony.

C. F. Elwell, of San Francisco, returns from Europe where he purchased the American rights to the Poulsen system of wireless telegraphy.

G. Marconi receives the Nobel prize of $20,000, in recognition of his wireless telegraph inventions.

Louis Cohen, in a Bureau of Standards bulletin gives the mathematical theory of coupled circuits in which the secondaries have distributed inductance and capacity.

### 1910

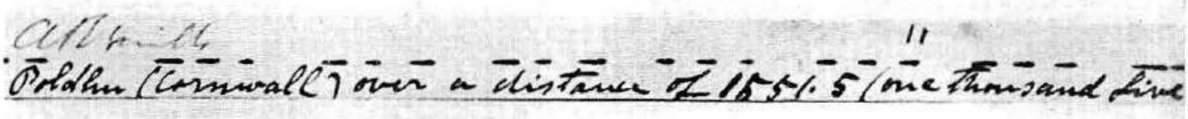
Major George O. Squier, of the United States Army, invents and patents a system of multiplex telegraphy and telephony, superimposing high-frequency signaling circuits upon existing wire lines.

Dr. George Seibt, during the past year associated with Dr. Lee de Forest, New York, in radio research work, returns to Berlin, Germany.

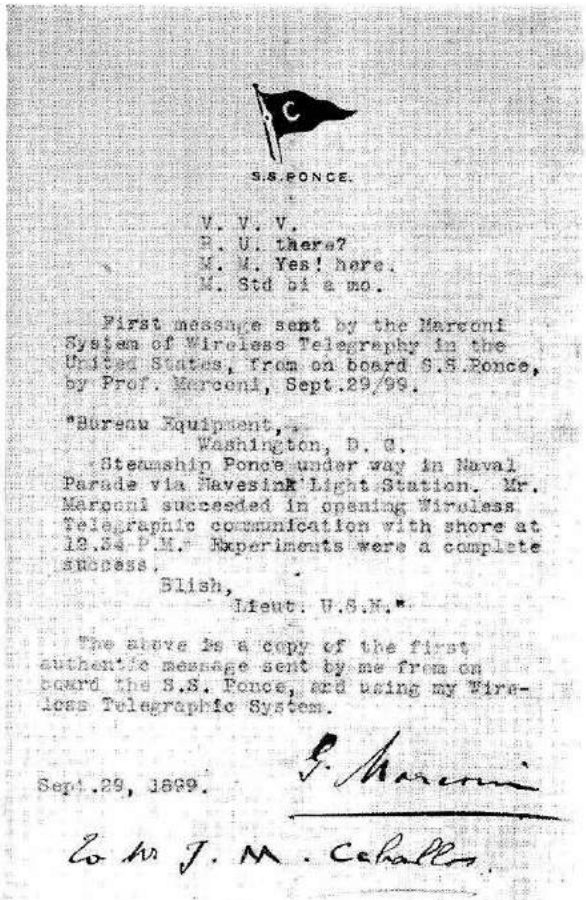
The Government arranges to transmit by radio from a station at Newport, R. I., weather reports to ships at sea.

E. Bellini and A. Tosi, of France, are granted U. S. patent 945440 covering a system of directed radio signaling.

An elective course is given at Massachusetts Institute of Technology in wireless telegraphy under the direction of Prof. C. R. Cross of the department of physics.




Tape record of reception on shipboard by Marconi from Poldhu station, 2099 miles distant, February, 1902.



S.S. PONCE.

V. V. V.
R. U. there?
M. M. Yes! here.
M. Std bi a mo.

First message sent by the Marconi System of Wireless Telegraphy in the United States, from on board S.S. Ponce, by Prof. Marconi, Sept. 29/99.

"Bureau Equipment,
Washington, D. C.
Steamship Ponce under way in Naval Parade via Navesink Light Station. Mr. Marconi succeeded in opening Wireless Telegraphic communication with shore at 12.34 P.M. Experiments were a complete success.
Blish,
Lieut. U.S.N."

The above is a copy of the first authentic message sent by me from on board the S.S. Ponce, and using my Wireless Telegraphic System.

Sept. 29, 1899. G. Marconi

To Mr J. M. Ceballos.

First message sent and received in the U. S. by wireless, Sept. 29, 1899.

At the General Electric works, Schenectady, N. Y., radio signals are received from Japan.

Air-plane radio experiments are conducted at Fort Sam Houston, Texas, by Lieut. B. D. Foulois, using a Wright plane.

The Glace Bay, Novia Scotia, station of the Marconi Wireless Telegraph Company, opened, September. This station works with Clifden, Ireland. The trans-Atlantic tariff is 17 cents per word.

The Wanamaker Company, New York, establishes private radio stations in New York and in Philadelphia for the exchange of company message traffic.

An Act is approved by the U. S. Government requiring radio equipment and operators on certain types of passenger-carrying vessels.

F. K. Freeland invents an electric oscillator system; U. S. patent No. 973826.

The cableship *Joseph Henry* is equipped with a 2-k.w. radio telegraph installation, in New York, for use at sea.

Walter Wellman's dirigible balloon "America" drifts helplessly over the Atlantic Ocean (October 18). The *R.M.S.S. Trent* picks up the radio call for help. Rescue followed.

### 1911

The Lodge-Muirhead patents covering inventions in wireless telegraphy are acquired by the Marconi Wireless Telegraph Company.

A radio section is organized by the Department of Commerce, Washington, D. C., to enforce the provisions of National radio legislation.

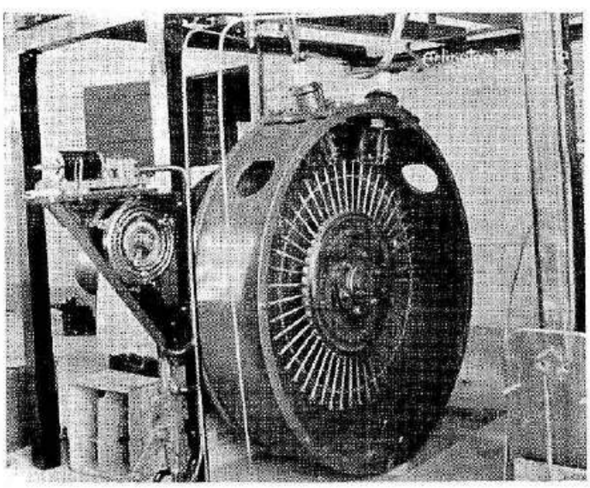
The United States Signal Corps, in Alaska, operates 2,633 miles of submarine cable, and nine wireless telegraph stations. In the Philippine Islands the Army operates seven wireless telegraph stations.

The United Wireless Telegraph Company reports 500 radio stations equipped and in operation.

The Eiffel Tower, Paris, France, is equipped for long-distance wireless telegraph operation.

S. M. Kintner is appointed general manager of the National Electric Signaling Company, Pittsburgh, Penna. This company controls the Fessenden radio patents.

Radio telegraph signals are transmitted directly from San Francisco, California, to Hokushu, Japan.



Rotary gap used with Fessenden 100 kw. 500-cycle spark set at NAA, the Navy's first high-power station, (1912) at Arlington, Virginia.

The United States Signal Corps has in operation in Alaska nine radio telegraph stations, the Navy, four.

### 1912

The Sayville, Long Island, New York, radio station of the Telefunken Company, of Germany, is completed.

The Association of Wireless Telegraphists, London, is formed.

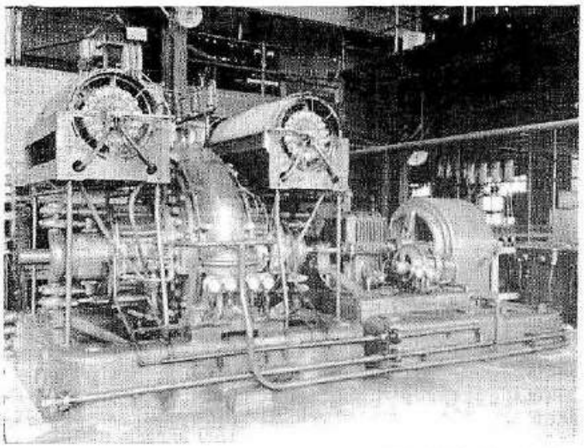
The Marconi Wireless Telegraph Company of America acquires the property of the United Wireless Telegraph Company.

The Marconi Company, in England, secures the important radio patents of Bellini and Tosi, Italian inventors.

The wreck of the *S. S. Titanic,* on April 15, with a large loss of life, was rendered less dreadful by the saving of many lives through radio communication to nearby ships.

An International Radio Telegraph Conference is held in London, June 4. Important regulations governing the handling of radio traffic are approved.

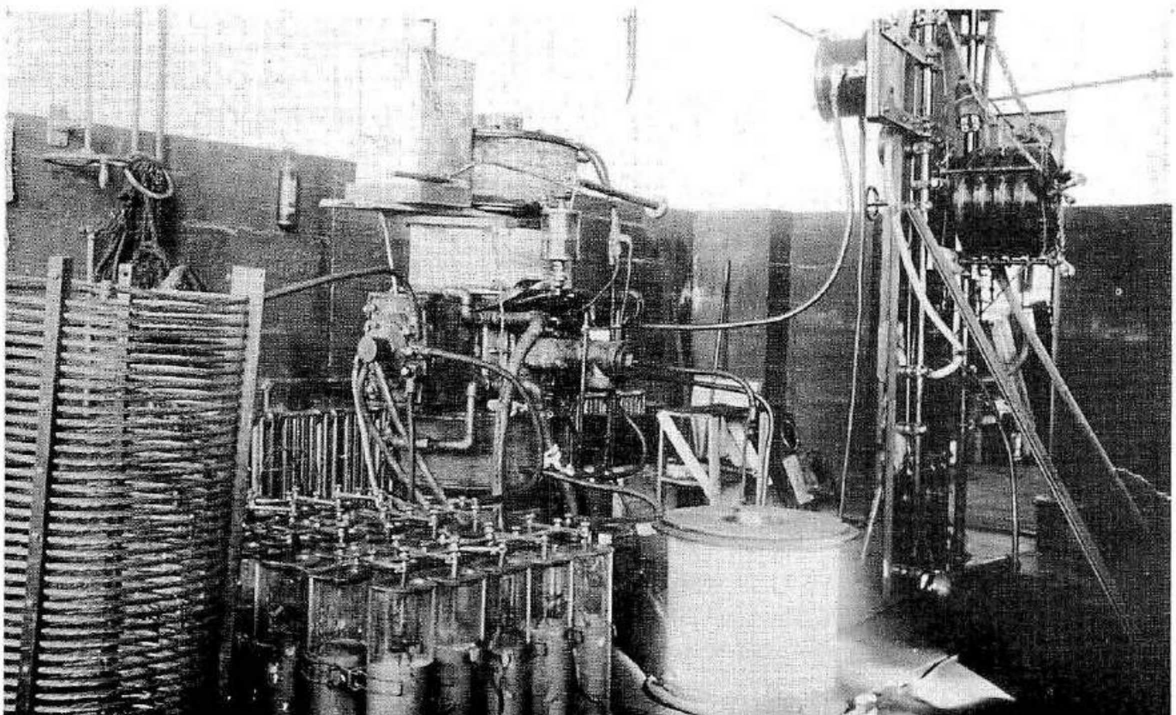
An Act is approved by the United States Government, July 23, extending the Act of 1910, to cover cargo vessels, and requiring an auxiliary source of power on ships, and two or more skilled operators in charge of radio apparatus on certain types of passenger-carrying vessels. On August 13, an Act is approved providing for the licensing of radio operators and transmitting stations.



Alexanderson r.f. alternator, as installed at the RCA station in New Brunswick, November 1919.

The Government of Canada arranges with the Marconi Company, September 17, to operate existing radio stations at points along the Great Lakes until the year 1931, and to erect additional stations.

The Institute of Radio Engineers, New York, is organized, May 13, consolidating the



60 kw. Federal arc transmitter, at Tuckerton Station, WGG, in 1915.

Wireless Institute of New York, and the Society of Wireless Telegraph Engineers, Boston, Mass.

The following wireless telegraph companies report for the year: Atlantic Communication Company; New York; Federal Telegraph Company, San Francisco; Marconi Wireless Telegraph Company of America, and Tropical Radio Telegraph Company, New Orleans. The number of radiograms handled totaled 285,091; number of transmitting stations operated, 74; total income $669,158, and total expense $664,420.

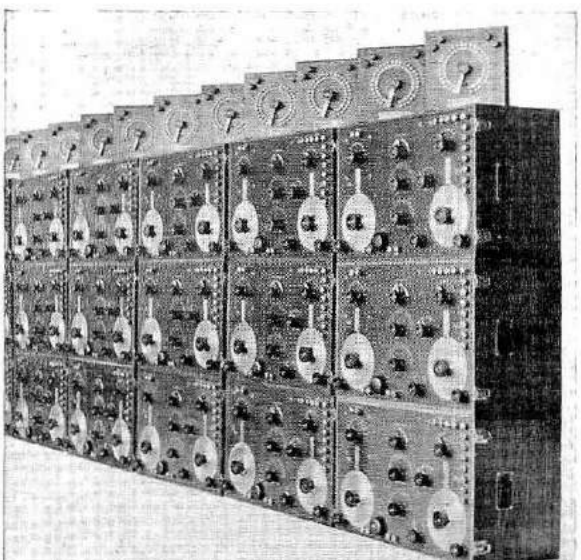
By the Poulsen wireless system signals are transmitted and received at Pacific Coast stations at the rate of 140 words per minute. The received signals produced on photographic tape.

Edwin H. Armstrong, New York, experiments with audion circuit improvements, which he later patents.

Engineers of the Western Electric Company, New York, begin experiments with de Forest's audion with a view to employing it as a telephone repeater, or as an element of a repeater system.

It is estimated that this year there are ten thousand amateur radio experimenters in the United States.

This year thirteen Bills were introduced in the Congress and Senate, having as their purposes regulation of radio operation.



Stack of 500 receivers, type IP 500, built by Wireless Specialty Apparatus Co., Boston, Mass., during World War I.



Edwin Howard Armstrong, the "super"-amateur.

In April of this year the United States Government ratified the provisions of the Berlin radio conference of 1906.

1913

A Safety-at-Sea Conference is held in London, at which the utility of radio communication is given considerable attention.

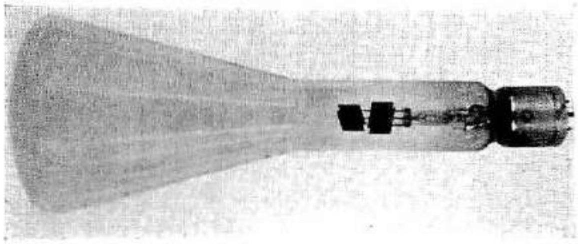
The Marconi Wireless Telegraph Company of America begins construction of high-power transmitting stations at Belmar, and New Brunswick, N. J. Through the British Marconi Company a twenty-five year contract with Norway has been signed for service between the American stations and a station at Stavenger, Norway.

Dr. Langmuir of the G-E Research Laboratory developed the high-vacuum, high-voltage tube and did early work on thoriated-filament cathodes for vacuum tubes.

1914

Radio telegraph service is inaugurated, September 24, between San Francisco, Calif., and a station near Honolulu, Hawaii.

Edward H. Armstrong, of Columbia Uni-



Hot cathode, low voltage cathode ray oscillograph tube, 1922.

versity, New York, patents circuit arrangements in connection with three-electrode vacuum tubes which materially improve methods of radio reception. (U. S. patent 1113149, October 6.)

For radiotelephone purposes on the Delaware, Lackawanna and Western Railroad, de Forest two-step amplifier radiophone equipment is installed.

The only direct communication between the United States and Germany is through the Sayville, N. Y., radio station, working with Nauen, Germany.

E. H. Colpitts, New York, develops a vacuum tube modulator system for telephony and radio telephony.

The super-dreadnaught *Moreno* is built in the United States for the Argentine government, equipped with the most modern electric systems and devices. The radio telegraph equipment is of German design and manufacture; Telefunken quenched-spark transmission, and variometer tuned receivers.

**1915**

Saul Dushman, of the General Electric Company, develops the Kenotron current-rectifier.

De Forest's Ultra-audion three-step (cascade) audio amplifier is announced and introduced into practice.

U. S. Patent issued to E. H. Colpitts of New York covering the invention of a push-pull microphone arrangement, April 27, No. 1,137,384. Applied for in May, 1914. Other claims were covered in Patent No. 1,128,292 issued February 16, 1915. The claims were filed in January, 1914.

Leonard F. Fuller reads an important A.I.E.E. paper, April, dealing with the continuous wave system of radio telegraphy (Poulsen arc system) used between San Francisco and Honolulu by the Federal Telegraph Company.

A memorial fountain and tablet is dedicated in Battery Park, New York, May 12, to the memories of radio telegraphers who lost their lives at sea in the performance of duty. George Eccles, of Almonte, Ontario, Canada, was the first man so to die; his ship, the *Ohio*, foundered in Pacific waters in 1909.

Radio telephone transmission in one direction between New York and Honolulu is accomplished, September 29, by A. T. & T. Co., with the co-operation of the U. S. Navy.

Speech is successfully transmitted by radio telephone by the telephone company from Arlington, Va., to Paris, France, October 21. Western Electric Company improvements in radio transmission were employed, particularly the arrangement suggested in U. S. Patent 1,350,752, issued to Van der Bijl.

The Radio League of America is organized, with W. H. G. Bullard, Nikola Tesla, R. A. Fessenden and Lee de Forest as honorary members. This organization thrived but a short time.

The National Amateur Wireless Associa-



First photo-radiogram sent by RCA, using Ranger process, Nov. 28, 1924.

tion organized, October, with G. Marconi as president. Having only commercial sponsorship, this organization accomplished little and soon died.

1916

The Navy Department contracts with the Federal Telegraph Company to erect radio stations at San Diego, Calif., and at Pearl Harbor, Hawaii, and Cavite, Philippine Islands.

Radio telegraph communication is established between San Francisco and Japan, November 15.

E. L. Chaffee, Somerville, Mass., procures U. S. patent 1,189,791 covering a form of spark-gap for radio transmission.

General Electric installed two vacuum tube radio telephone transmitters, one on the USS Wyoming and the other on the USS Virginia. These were used on the southern practice cruise in the Caribbean Sea in the spring of 1916.

General Electric produced and published papers on circuits for production of frequencies from vacuum tube oscillators up to 15 megacycles.

1917

The Institute of Radio Engineers establishes an annual award of a Medal of Honor in recognition of meritorious contribution to radio.

Edwin H. Armstrong, New York, is the first recipient of the I.R.E. Medal of Honor, in recognition of his work in inventing regenerative amplification in radio reception. (His claims, together with those of de Forest and Logwood were destined to become matters for a legal contest which continued until 1934, the final decision favoring de Forest's claim to this invention.)

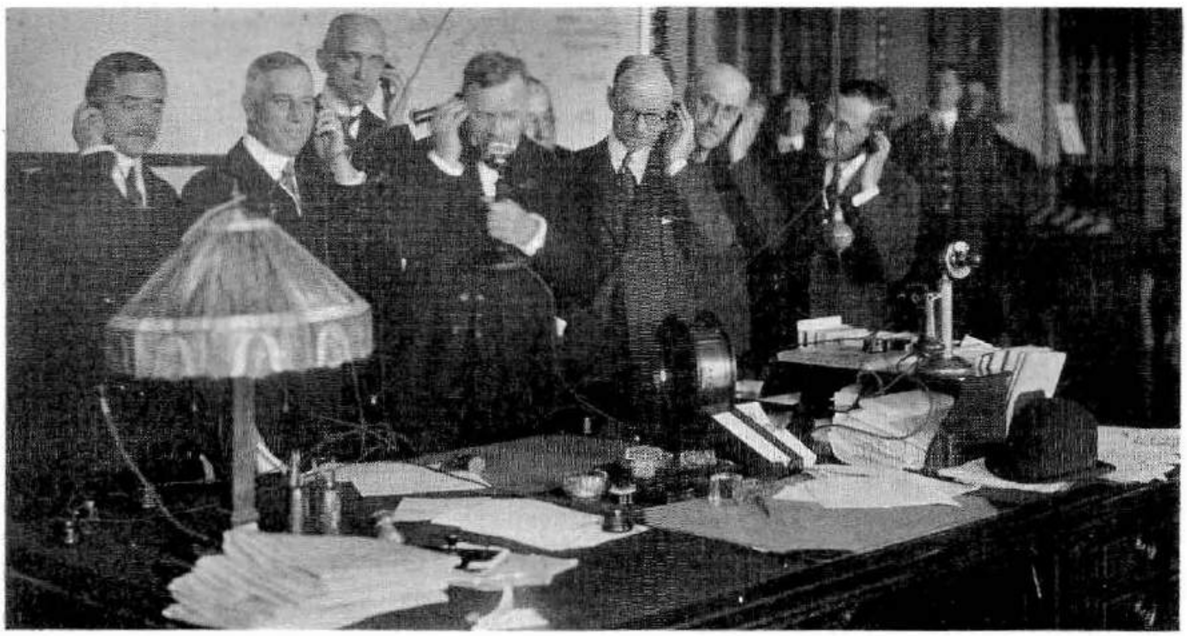
R. A. Heising is granted U. S. patent 1,232,919 for a thermionic volt-meter.

George A. Campbell, of the American Telephone and Telegraph Company, procures U. S. patents 1,227,113 and 1,227,114 covering the invention of electric "filter" circuits which make possible improvement in methods of signaling by means of "carrier" currents on wire lines.

A telephone conversation is held between naval officers at Mare Island, California, and the captain of the battleship *New Hampshire,* cruising in the Atlantic Ocean. Transmission was over the wire lines of the A. T. & T. Co., from Mare Island to Arlington, Va.; there repeated automatically into the radio system. Conversation was in both directions.

Direct radio telegraph communication is established between stations at Arlington, Va., and Pearl Harbor, Hawaii, Sept. 29.

All transmitting radio stations are, for the period of the war, taken over by the



Telephoning by wireless from land to sea. Secretary of the Navy Josephus Daniels talks to the *U.S.S. Hampshire* in World War I.

Government, either for operation or to be discontinued.

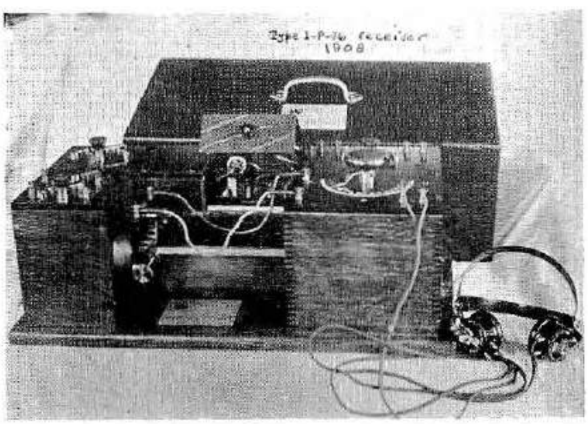
Prominent companies manufacturing and marketing radio telegraph equipment are: Cutting and Washington, de Forest Radio Telephone and Telegraph Company, C. Brandes, John Firth, and Marconi Wireless Telegraph Company of America, New York; Kilbourne and Clarke, Seattle, Wash.; Wireless Specialty Apparatus Company, Boston; National Electric Signaling Company, New York. The de Forest Company advertises a single oscillating audion, mounted on a panel, with switch, and resistance unit, priced at sixty dollars.

The Haller Cunningham Electric Company, San Francisco, report completing installations of radio telegraph equipment of that company's manufacture at nine land stations and on thirty steamships, rated at from one-half to twenty-five k.w.

Two-way radio telegraph transmission between a ground station and an airplane in flight, made by Captain C. C. Culver, at a distance of 119 miles. The transmitter was



Grebe receiver, much used in days immediately following World War I.



Famed receiver 1-P-76, usually called "I-P" instead of "1-P". Designed by G. W. Pickard and widely used before and during World War I.



Bob Marriott, founder of I.R.E., in apparent dire danger from Roy Weagent (right) and an unidentified "bad-boy bandit" on the left. Scene: Seattle, Washington, 1919.

of 180 watts. Communication was carried on also between two airplanes in flight.

The Pan American Wireless Telegraph Company announces plans to inaugurate service between the United States and South and Central American stations. The company is affiliated with the Marconi Wireless Telegraph Company of America. Edward J. Nally is president.

German war vessels, named "sea rovers" and otherwise as the MOEWE, the SEEADLER and the EMDEN, equipped with radio, appear to be picking up sufficient information as they cruise, to enable them to pounce upon and destroy cargo ships belonging to the Allies.

A disastrous explosion and fire at Halifax, Nova Scotia, temporarily interrupts wire communication. Radio is used to summon aid from other cities.

### 1918

The manufacturing shops of the Marconi Wireless Telegraph Company, at Roselle Park (Aldene), N. J., are working at full capacity turning out radio equipment for war needs.

Lloyd Espenschied, New York, procures U. S. patent No. 1,256,889 for the invention of a duplex radio telegraph system.

A photographic tape-recorder system for



Early video apparatus used by C. Francis Jenkins, television pioneer.

radio telegraph reception is invented by C. A. Hoxie, Schenectady, N. Y., and is used in certain radio stations.

The House of Representatives, Washington, on July 5, passes a resolution authorizing the president to take over the management of telegraph and telephone systems and lines, and of radio stations, due to war conditions.

G. Marconi is awarded the Franklin Medal, of the Franklin Institute, Philadelphia, in recognition of his work in wireless telegraphy.

Thomas R. Taltavall dies. (Born in England 1853.) He is succeeded as editor of the journal *Telegraph and Telephone Age,* New York, by Donald McNicol.

Lieut. Col. Morris N. Liebmann, formerly vice-president of Foote, Pierson & Co., New York, is killed in action in France, August 8. His associate, Emil J. Simon, New York, sets up a sum of $10,000, the annual interest of which creates the Liebmann Award of the I.R.E., amounting to $500.

The Pan American Wireless Telegraph and Telephone Company plans erection of powerful transmitting stations in various locations in South America.

It is reported that the Government has paid the Poulsen Wireless Telegraph Company $1,750,000 for the company's present "arc" transmitting stations in the United States, the Philippines, and the Sandwich Islands.

Vacuum tube devices, the Dynatron and Pliodynatron, are commercially introduced by the General Electric Company, for use in radio signaling and for power conversion requirements.

For communication needs in France the U. S. Signal Corps used 1,000,000 cells of primary batteries, 285,000 vacuum tubes for radio, 8,000 sets of one type of radio receiver, 110,000 telephone sets for field use, and one order for insulated wire called for an amount exceeding 350,000 miles in length.

1919

On his trip to Paris to participate in the Peace Conference, President Woodrow Wilson was in continuous communication with the United States and Paris. The President, on board the *S. S. George Washington,* was convoyed by the *U. S. S. Pennsylvania,* the latter vessel equipped with a 30-k.w. Federal "arc" transmitter, a 10 k.w. Lowenstein "spark" transmitter, a short-range radio telephone transmitter, and a short-range vacuum tube transmitter, the latter used for communication with the *George Washington.*

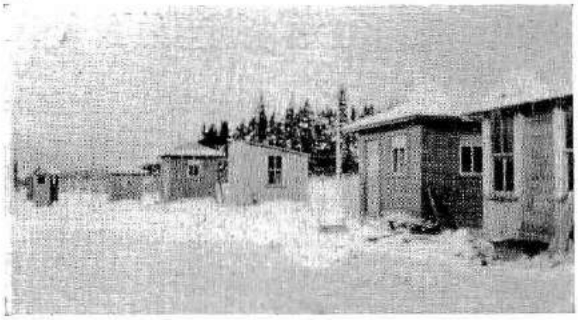
E. F. W. Alexanderson, of the General Electric Company, delivers a technical paper describing the invention of his "Barrage" radio receiver, a directional system.

The Independent Wireless Telegraph Company, incorporated under the laws of Delaware, establishes general offices in New York. Charles J. Pannill is vice-president and general manager, and Harry Shoemaker, chief engineer.

E. F. W. Alexanderson receives the I. R. E. Medal of Award for noteworthy contribu-



DAVID SARNOFF



U. S. Navy transatlantic receiving site at Otter Cliffs, Me., in World War I.

tions to radio engineering.

The amateur radio journal QST suspended during the war, is resumed by the American Radio Relay League, which ceased operations on April 1, 1917.

Bills are introduced in Congress having for their purpose permanent Government control of all radio stations. It appears that the widespread resentment of amateurs had more to do with defeat of these bills than had objections of commercial companies.

The audions operating at 22½ volts on the plate, in use prior to the war, are now largely replaced by improved tubes known as the VT type.

There are now available radio transmitting tubes having outputs of one-fourth k.w. The VT-2 employs a plate potential of 300 volts.

Poulsen arc radio transmitters have been developed and are in service rated at 1,000 k.w., with a 25 per cent 2-hour overload capacity. Five years ago converters of 30 k.w. normal full load were the largest in use.

For experimental and public use radio tube VT is marketed by the Marconi Wireless Telegraph Company of America, the sale price being $7.00, the socket $1.50 additional. Plate potential as detector is 20 to 60 volts; as amplifier, 60 to 110 volts.

Roy A. Weagant, New York, reports having developed means of reducing disturbances to radio reception caused by atmospherics, or "static."

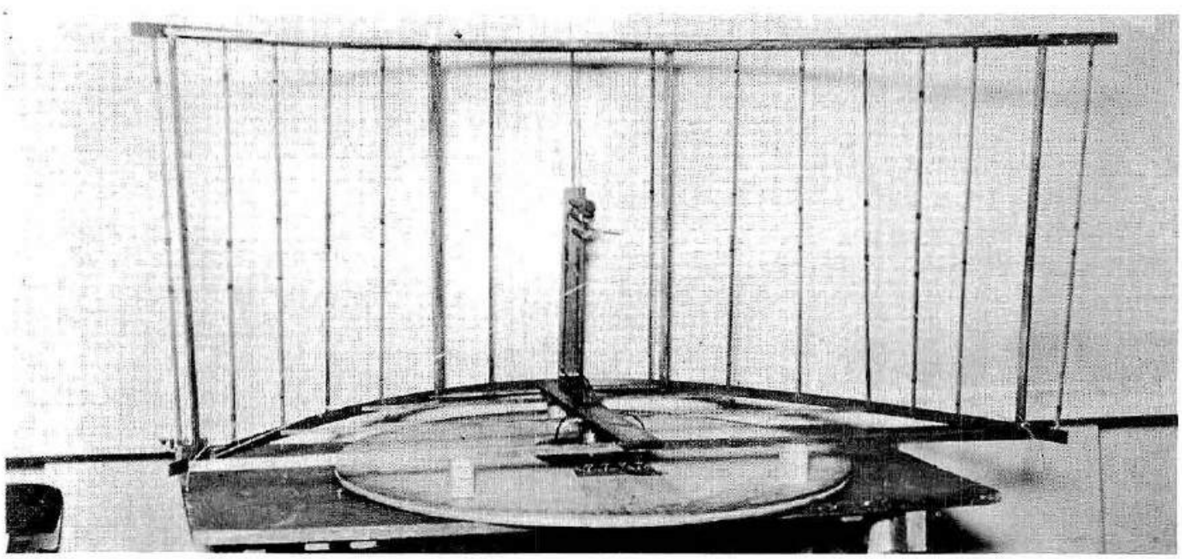
The American Engineering Standards Association organized, May.

Most radio receivers, commercial and amateur, are still equipped with crystal detectors, but vacuum tubes are rapidly coming into practical use.

Major-General George O. Squier, Chief Signal Officer, U. S. Army, receives the Franklin Medal, from the Franklin Institute, in recognition of meritorious work in improving electric communication.

The Kilbourne and Clark Manufacturing Co., builders of radio equipment, erect a new and larger factory, at Seattle, Wash.

The General Electric Company purchases the holdings of the British Marconi Company in the Marconi Wireless Telegraph Company of America, the name of the latter company being changed to Radio Corporation



Demonstration apparatus used by Marconi at a lecture before the A. I. E. E.-I. R. E., in June 11, 1922, to demonstrate ultra-short waves.

of America (October). Edward J. Nally is elected President of the new company.

1920

E. F. W. Alexanderson is appointed Chief Engineer of the Radio Corporation of America, January 1st.

The Radio Corporation of America begins the installation of 200-k.w. Alexanderson alternators at Bolinas, Calif., and Marion, Mass.

Radio telegraph stations and properties taken over by the Government under war time powers are returned to their owners at midnight, February 29th.

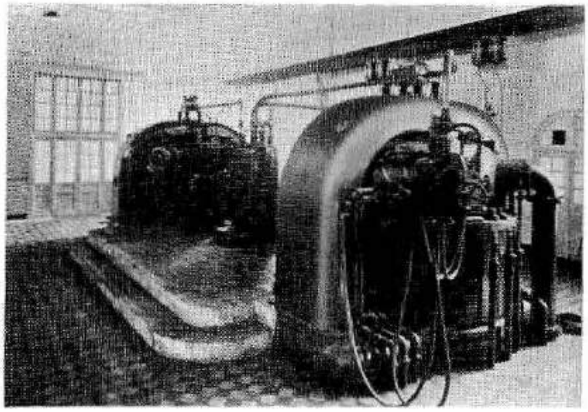
Following out the provisions of H.B. 9822, passed in Washington, December 8, 1919, the President appoints as delegates to an International Communications Conference, A. S. Burleson, W. S. Benson and Walter S. Rogers.

The Government calls for bids for the sale of large quantities of surplus radio and telegraph and telephone apparatus purchased for war needs and not used.

Alfred N. Goldsmith and Edward Blakeny, New York, develop a satisfactory siphon recorder receiving system for radio telegraphy. The system is installed by RCA.



J. ANDREW WHITE
First broadcast announcer of RCA.



These two 1000-kilowatt Federal Poulsen arcs made the U. S. Navy Lafayette station, near Bordeaux, France, the most powerful ever built. A workman is said to have departed in haste because his trowel persisted in "walking" toward the arc magnet every time he put it down to fit a tile in place.

G. Marconi receives the I. R. E. Medal of Award, for meritorious contributions to radio telegraphy.

The Tropical Radio Telegraph Company, a subsidiary of the United Fruit Company, New York, operates ten long-distance radio stations at points in Central America, and in South America.

The Radio Corporation of America purchases a 6,000 acre tract at Rocky Point, L. I., N. Y., on which is begun the erection of a Radio Central station, comprising a number of operating units for communication with European stations and stations in South America.

Emil J. Simon, of the Radio Communication Company, New York, inaugurates intercity radio telegraph service between New York, Chicago, and Detroit.

The Radio Corporation of America, May 15th, inaugurates radio telegraph services between stations at Chatham and Marion, Mass., and stations at Stavanger and Naerobe, Norway.

Telegraph, telephone and radio engineers located in Chicago and vicinity organize (May) a section of the Western Society of Engineers. Frank F. Fowle is chairman, and Stanley R. Edwards, Vice-chairman of the section.

Roy A. Weagant, New York, is awarded the Liebmann Memorial Prize of $500, by the Institute of Radio Engineers.

The Westinghouse Company's radio station KDKA, at Pittsburgh, Penn., broadcasts returns of the national elections, November 2nd.

Paul Godley, of New York, goes to Scotland where (December) he sets up a radio receiver with the object of attempting to intercept radio transmissions from American amateur stations. He succeeds. His receiver comprised a regenerative tube rectifier, a separate oscillator, four stages of resistance-coupled, intermediate frequency amplification, a second rectifier and two stages of audio amplification. This was an adaptation of the Superheterodyne radio receiver developed during war activities in France.

Development, design and manufacture by General Electric of the early receiving and transmitting tubes made available to the public by R CA (UV-200, 201, 202).

General Electric built a 100-watt and a 500-watt design of commercial marine CW tube transmitters. These were the first two such items built for this application.

### 1921

July 2, Dempsey-Carpentier fight at Jersey City, N. J., broadcast by radio by RCA.

Vacuum tubes UV-200 and UV-201 for storage battery operation, and WD-11 for dry-cell operation developed by RCA.

RCA station at Rocky Point, L. I., opened, Nov. 5.

RCA broadcast station at Roselle Park, N. J. (WDY) opened Dec. 15. Continued until Feb. 15, 1922, when its operation was transferred to WJZ, Newark, previously opened by Westinghouse.

RCA installs 200-kw alternator at Tuckerton, N. J.

Chatham, Mass., coastal station opened by RCA employing tube transmitters.

### 1922

Oct. 15. First use by RCA of tube transmitters for service from the U. S. to England and Germany.

RCA begins substitution of tube transmitters on ships to replace spark sets.

RCA begins replacement of crystal receivers by tube receivers on ships.

UV-199 and UV 201-A receiving tubes, developed by G. E., introduced by RCA; thoriated tungsten filaments employed.

Two-way radiophone conversation carried on between *S.S. America* at sea and subscriber telephones over wire lines.

WEAF broadcasts first advertisement-sponsored program (a real-estate company) Sept. 7.

### 1923

May 15. Broadcast stations WJZ and WJY opened by RCA in New York. WRC opened in Washington August 1st.

Hazeltine's neutrodyne introduced. March.

G-E development of water-cooled transmitting tubes and their use in 20-kilowatt CW telegraph transmitters.

### 1924

Armstrong demonstrates the Superhetrodyne receiver. March 6.

November. RCA experiments with radio photographs across the Atlantic.

RCA introduces for marine use C.W. transmitters using master oscillator power amplifier circuits.

Shortwave, low power transmission developed for long distance transmission.

RCA markets the Superhetrodyne receivers for broadcast reception.

Broadcasting used in political campaigns.

RCA circuit to Argentina opened Jan. 24.

### 1925

WJZ transmitter constructed at Bound Brook, N. J.

A. C. radio receivers introduced.

Dynamic loudspeakers introduced.

Magnetic pick-up phonograph recording and reproduction developed.

RCA opens radio circuit to Dutch East Indies, July 16.

Direction-finders introduced on ships.

— Compiled by Donald H. McNicol.

## — the Mysterious Ether

"No familiarity with the subject removes the feeling of vague wonder with which one sees a telegraphic instrument, merely connected with a length of 150 feet of copper wire run up the side of a flagstaff, begin to draw its message out of space and print down in dot and dash on the paper tape the intelligence ferried across 30 miles of water by the mysterious ether."

Dr. J. A. Fleming, F.R.S.
(The Marconigraph, London, England
April, 1911)



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